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FAT EMBOLISM

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FAT embolism is a medical entity that is frequently unrecognized. For a long time the existence of fat embolism was doubted, but in the light of present knowledge of the pathology of this condition, there can be no question of the validity of the syndrome. Vance⁹ demonstrated fat in the pulmonary capillaries of over 50 per cent of traumatic deaths. Robb-Smith⁵ investigated 125 traumatic deaths and found 41 cases in which fat embolism was considered as the primary or major contributing cause of death. From the pathologic investigation of these cases, it is evident that many minor quantities of fat embolism go unrecognized in non-fatal cases, and probably account for many of the previously unexplainable symptoms, such as post-traumatic delirium, temperature elevation and chest pain, that fortunately have resolved spontaneously. It is also painfully evident from the autopsy studies that too many antemortem diagnoses of fat embolism are being missed. The mortality rate varies in different series of cases, from 5 to 93 per cent. This variation undoubtedly lies in the difference of criteria which are depended upon for making the diagnosis.

PATHOGENESIS

Fat embolism usually arises from trauma and is associated most frequently with fractures. Warren,¹⁰ reviewing 100 consecutive cases of fat embolism in the Army Institute of Pathology, found 91 due to trauma involving fractures of one or more bones. Of these, 82 per cent had fracture of the femur or tibia or both. It is obvious that fractures of the long bones of the lower extremities are the injuries most prone to result in fat embolism. Other causes are

burns, crush injuries, surgical operations and acute pancreatic necrosis.

There is some controversy as to the origin of the fat in fat embolism, but it is generally conceded that it comes directly from the bone marrow. Some workers⁶⁻¹⁰ have reported finding bone marrow, as well as fat, in the lung capillaries.

Three factors must be present for fat embolism to occur:

1. Fluid fat must be released from the fat cells.
2. There must be severed veins without collapsed ends.
3. The fluid and fat surrounding tissue fluids must be under pressure greater than the venous pressure.

These three factors are frequently encountered in trauma involving fracture of a long bone. The bone marrow fat is easily liquefied by trauma and the attachment of veins to the bone structure holds them open after they have been ruptured. The hemorrhage and exudate which appears about a fracture are sufficient to raise the local pressure high enough to push the liquid fat into the open vein. This fat then travels to the lungs, and occasionally through them, into the systemic circulation, involving especially the brain because of its richer blood supply. The fat acts as a temporary embolus,⁸ plugging the capillaries and inciting a perivascular inflammatory response of hemorrhage and edema. This temporary nature of the embolization probably accounts for its cyclic pattern. Fat embolism is the most common in the fourth decade of life and affects men about eight times as frequently as women.

DIAGNOSIS

The diagnosis of cases of fat embolism is in direct proportion to the index of suspicion on the part of the physician. As will be seen under differential diagnosis, there are a number of conditions that may be confused with fat embolism, especially the milder forms, but the full blown picture of fat embolism should readily be diagnosed.

There are two main types of fat embolism, the pulmonary and the cerebral, depending on whether the lungs or the brain is the major focus of involvement. In many cases a combination of the two is seen, since in all of cerebral involvement cases fat must pass through the pulmonary capillaries (or theoretically may rarely pass through a patent foramen ovale). In the typical case there is a history of injury, usually a fracture of one of the long bones of the lower extremities. This is followed by a clear period lasting several hours to two or three days. A premonitory sign is apprehension on the part of the patient, and he will often complain of tightness in the

chest and some difficulty in breathing. The pulse and respiration become suddenly elevated and the temperature goes up to 102 or 103 F., and may go higher. Blood pressure remains unchanged and usually is at normal level. In the pulmonary type, rales may be heard in the chest but roentgenograms at this time are negative. Scuderi⁷ has pointed out that 24 to 48 hours after onset of symptoms roentgenograms of the lungs show diffuse clouding, suggestive of pulmonary edema, and patchy areas of infiltration suggesting bronchopneumonia. The typical picture in both the pulmonary and the cerebral types is cyclic, but the process may be very mild and occur only once or may be fulminating and rapidly fatal. In the severe pulmonary form, the patient gradually becomes more cyanotic and dyspneic, and delirium may appear. He later develops a cough and brings up blood-tinged sputum. The lungs fill with fluid and death in this type is from asphyxia.

In the cerebral form, there may or may not be any pulmonary signs. Spring⁸ believes that the pulmonary type occurs primarily in older or debilitated individuals, with a weakened myocardium, whereas in the younger patients the fat will be forced through the lung capillaries into the systemic circulation and thereby a higher incidence of the cerebral type of fat embolism will result. About one-third of the cerebral cases have no clinical evidence of pulmonary involvement.

The cerebral form starts out similar to the pulmonary with rapid pulse, dyspnea, restlessness, and temperature elevation, but rapidly develops signs of cerebral irritation such as delirium, stupor and unconsciousness. They may have transitory clonic twitchings, or spastic involvement of muscles, and paralysis. Babinski test may be positive, but no localizing signs are present. Pupillary and corneal reflexes may disappear. Depending upon involvement of the heat regulatory center, the temperature may go up to 106 or 107 F. Death usually occurs in one to four days.

From 24 to 36 hours after the onset of symptoms, especially in the cerebral type, petechiae may be found and are of great clinical and diagnostic significance. These usually occur at the base of the neck, axillae, groin, and trunk, and are also seen in the conjunctivae. The petechiae are rarely seen distally on the extremities. Fat can occasionally be found in the sputum and urine by special technics but these tests are not very dependable and a negative test does not rule out the possibility of fat embolism. Blood examinations early in the course of fat embolism are not significant but later tests show a drop in the red blood count and hemoglobin. This is thought to be due to loss of red cells in the pulmonary exudate,² and may confuse the picture with that of internal hemorrhage.

DIFFERENTIAL DIAGNOSIS

1. Shock. This usually comes on immediately or shortly after an injury. The blood pressure is usually normal in cases of fat embolism and temperature is elevated in contrast to the findings seen in shock. One cannot but wonder if many cases of secondary, or delayed shock, are really cases of fat embolism.

2. Head injury. Subarachnoid hemorrhage may be differentiated by spinal puncture, which is negative in fat embolism. A subdural hematoma has focalizing signs.

3. Delirium tremens. The delirium and hallucinations here usually follow a different pattern. There is a history and often evidence of alcoholism. Early dyspnea and pyrexia are not as marked as in fat embolism.

4. Bronchopneumonia. This is the most difficult to differentiate, and even in proved cases of fat embolism, the patient is placed on antibiotics to prevent bronchopneumonia as a complication. The presence of petechiae and the signs of cerebral involvement are helpful in differentiating fat embolism from bronchopneumonia. In those cases in which one can find fat in the sputum and urine, the diagnosis of fat embolism is more easily substantiated.

5. Pulmonary embolism. This comes on later than fat embolism as a rule, and in those cases that are not rapidly fatal, it has characteristic lung findings. Remember the dictum: shock in three hours, fat embolism in three days, pulmonary embolism in three weeks.

6. Internal hemorrhage. The red blood count and hemoglobin may fall rapidly in either hemorrhage or fat embolism, but in fat embolism the temperature is elevated and blood pressure is normal in contrast to the findings with hemorrhage.

TREATMENT

In any discussion of treatment, the proper handling of cases should be mentioned in an attempt to prevent fat embolism. Traumatic cases, where fat embolism is most frequently encountered, should be handled gently. Fractures should be properly immobilized and splinted prior to transportation. Manipulation of fractures should be as gentle as possible, and following manipulation and immobilization, the part should be elevated to minimize post-traumatic swelling.

Active treatment of fat embolism consists primarily in supportive measures, the most important of which is oxygen therapy to combat cyanosis and dyspnea. Intravenous fluids must be given in guarded quantities so as not to influence adversely the pulmonary and cere-

bral edema. Blood transfusions are often necessary to combat anemia. Cool sponges are helpful in reducing hyperpyrexia. It is believed that vein ligation,⁴ which has been recommended, should probably be performed more frequently, especially in patients with severe cerebral involvement, and in those showing progressive showers of emboli. The superficial femoral can be ligated for tibial fractures, the profundus femoral for fractured femurs, or the femoral vein itself for combination fractures.

The use of drugs to saponify the fat in the veins has been reported as unsuccessful. Ether anesthesia has been suggested as a means of dissolving the fat in the blood but reports of experimental work on this subject by Bisgard and Baker¹ indicate that it is not helpful and might even be deleterious. In their experience, however, they showed that operations performed under tourniquet hemostasis reduced the quantity of fat embolism. They suggest that following surgery the tourniquet be released gradually to allow complete filling of the veins before final release of the tourniquet, and thereby prevent sucking fat into the open veins.

Kingsbery and Wilkinson³ reported a case of compound fracture of the tibia, complicated by fat embolism, in which the patient went into deep coma. The patient responded to oxygen therapy and decompression of the wound by drainage of a large quantity of sero-sanguineous fluid containing fat droplets from the fracture site. In this case the decompression probably served to prevent further fat embolism at its source, and fortunately the patient was able to recover from the damage of previous showers of emboli.

PROGNOSIS

Spring² believes that the prognosis is good in the pulmonary type of fat embolism if the temperature stays below 102 F., the pulse rate less than 90 per minute, and blood pressure does not fall below 90 mm. systolic. A fatal outcome is rare if the patient survives four days from the onset of symptoms. In the cerebral type death occurs within a few days in the majority of the cases. It is in the cerebral type and in the more severe pulmonary type that vein ligations should be performed.

CASE REPORTS

CASE 1. Mrs. D. A., a 34 year old white woman, was injured in an automobile accident and admitted to the hospital on Aug. 24, 1946 at 6 p.m., with a laceration of the left ear, contusion of the chest overlying the sternum, but without evidence of fracture of the sternum, and fracture of the mid shaft of the left femur. The patient was conscious and rational on admission, without a history of coma. Blood pressure on admission was 96/70, temperature 100 F., pulse 120, and respiration 26. Blood pressure responded to plasma and

transfusion and pressure returned to normal (120/80). A short pentothal anesthetic was given about two hours after admission, a pin was placed through the left os calcis, the fractured femur was manipulated and Russell traction applied. The general condition following this procedure seemed excellent but the patient took an abnormally long time in responding from the anesthesia and seemed somewhat disoriented the following day.

Approximately 30 hours following admission her temperature rose to 103 F. and she was delirious at times. The following night her temperature went up to 106 F. and she became cyanotic, dyspneic, and comatose. Stimulants were given and the patient responded slightly, speaking in a light husky voice and complaining of chest tightness. Roentgenograms at that time revealed diffuse clouding in both lung fields, which was interpreted as suggesting bilateral pneumonitis. Rales were heard in both lung bases. The patient was placed in an oxygen tent to combat cyanosis, dyspnea, and restlessness. The following day further chest films were reported as showing bilateral pneumonia. Penicillin had been started at the time of admission. In spite of continued oxygen and blood transfusions, the course was gradually downhill. A chest specialist was called as consultant, because it was thought that perhaps chest contusion caused some mediastinal pathology, but this was not the case. Bronchoscopy of the lungs revealed no obstructed bronchi. An electrocardiogram taken on Aug. 27, 1946 was reported as indicating myocardial weakness with evidence of coronary disease (this finding has been reported in other cases of proved fat embolism). Blood findings in this case were essentially normal except for moderate secondary anemia. The patient's pulse became progressively more rapid and weaker, respiratory rate went up to 40 per minute, although the blood pressure remained around 102/80. She died, apparently from asphyxia, at 3:50 a.m. on Aug. 27, 1946, three days following admission.

Discussion. No autopsy was obtained in this case but its course leaves little doubt that it represents a rather typical case of the pulmonary type of fat embolism with some cerebral involvement. The complicating factor, as far as diagnosis was concerned, was the apparent chest injury which was considered to be the cause of the pulmonary signs until the terminal stages. The chest consultant, however, believed that the findings in the chest roentgenogram, along with the negative bronchoscopy, definitely ruled out the possibility of primary chest pathology as a cause of symptoms. In retrospect, one cannot help but wonder that if this had been recognized as a case of fat embolism earlier, and a femoral vein ligation performed on the second day, the patient might have survived.

CASE 2. Mr. L. R. B., a 26 year old white man, was injured on May 18, 1948 by being caught in a cathead of an oil derrick and spun several times before being rescued. He was given preliminary treatment for shock and splints were applied to the left arm and right leg, and six hours later he was transferred 100 miles for treatment of multiple injuries. At time of admission to the hospital the patient was in shock but blood pressure responded well to 1500 cc. of blood transfusion, one unit of plasma, and 1,000 cc. of glucose and saline. Investigation revealed fracture of the left scapula, left fourth, fifth, sixth and seventh ribs, with partial pneumothorax, extensive laceration of the left axilla, fracture of the mid shaft of the left humerus, amputation of right thumb, and compound fracture of right tibia and fibula. A chest consultant aspirated air from the left chest on two occasions, allowing

reexpansion of the lungs. By the following day the patient's blood pressure had gone up to 124/60 and his general condition was believed to be sufficiently improved to permit debridement and partial closure of the various wounds and reduction and fixation of fractures.

Following operation, the patient's general condition seemed quite satisfactory, but later that evening he began developing signs of pulmonary edema. He was given positive pressure oxygen inhalations and concentrated blood plasma. Urine on this day showed considerable blood and bloody sputum was expectorated. He was placed on a dehydration regime but his course was gradually downhill. He had lucid periods in which he seemed to be improving and then lapsed into a period of delirium and hallucinations or coma, with increase in dyspnea and cyanosis. In spite of oxygen therapy, transfusions, restricted fluids, concentrated plasma and diuretics, the pulmonary edema became worse and the patient died at 2:55 p. m. on May 22, 1948, four days after admission. Besides his extensive injuries, the immediate cause of death was believed to be due to fat embolism.

Discussion. With the cerebral signs of delirium and coma which this patient had and his evident pulmonary edema, this case was believed to be a mixed type of fat embolism, with involvement of both lungs and brain, even though no petechiae were found. An autopsy was obtained and the typical findings of fat embolism were noted in fat stains of lungs and brain. Because of the extensive and multiple injuries, I doubt if any vein ligation therapy would have been indicated.

CASE 3. W. J. W., a 25 year old white woman, was admitted on Feb. 27, 1949 after multiple injuries to both lower extremities when the car in which she was riding was struck by a train. She was not unconscious at any time following the accident and was rational and cooperative when seen in the emergency room at the hospital. Fractures of both lower extremities had not been splinted during transportation to the hospital. Blood pressure in the emergency room at the hospital was 136/72. Her injuries consisted of fracture of the right femur, fracture of both tibias and fibulas, fracture of the left ankle and metatarsals of the left foot. Examination revealed no injury to the pelvis, trunk, head, or upper extremities. She was given approximately $\frac{1}{2}$ Gm. of sodium pentothal while adhesive traction was applied to both lower extremities. No manipulation of the fracture sites was attempted, but traction was merely applied for immobilization and to relieve pain. Following this procedure the patient was observed for approximately one hour when she was seen to swallow and roll her eyes and it was thought that she was responding from anesthesia satisfactorily.

When next examined by the physician six hours later the same day she was in deep coma and did not respond to painful stimuli. Her blood pressure had dropped to 100/60. She was given intravenous fluids and blood transfusions with good response of the blood pressure but she remained in coma. Her temperature gradually mounted and coma remained profound. On the following day (24 hours following admission) multiple petechiae were found in the skin over the abdomen, chest, base of the neck, and also in the conjunctivae. Eye grounds were clear, no choking was present, and no retinal hemorrhages were seen. The blood pressure was 132/64, temperature was up to 102 F. (axillary), pulse was 136, and respiration 30 and stertorous. Red blood count was 2.95 million, white blood count 12,000, hemoglobin 58 per cent and urine showed 8 to 10 red blood cells per high powered field and 2 plus

albumin. Urine stain for fat was negative. A diagnosis of fat embolism was made and she was placed on a dehydration regime, given repeated blood transfusions, and placed in an oxygen tent because of the slight cyanosis, although lungs remained clear to percussion and auscultation. She was placed on penicillin and streptomycin to prevent infection. On the following day (March 1, 1949), spasticity was noted in all four extremities. There was some question as to whether this was due to cerebral damage or to hyperventilation. The patient was quite hyperpneic and respiration was stertorous. CO₂ combining power was found to be moderately elevated, 54 volumes per cent, as compared with 43 volumes per cent on Feb. 28, 1949. Neurosurgical and medical consultations were obtained and they concurred in the diagnosis of fat embolism. The neurosurgeon did not believe that signs suggested intracranial hemorrhage or head injury. The patient continued in deep coma and successive crops of petechiae appeared in the skin. Because of these repeated embolic phenomena, mounting temperature (105 F. axillary), and continued downhill course, a bilateral femoral vein ligation was performed about midnight of March 2, 1949, three days following admission.

The morning following the ligation, the patient's temperature went to 105 F. (axillary) but after that showed a gradual decline, as her condition continued to improve. She was given several repeated transfusions for her secondary anemia. No further crops of petechiae occurred. Thirty-six hours following ligation of the veins, the swallowing reflex reappeared and two days later she began opening her eyes and looking about the room with much improvement in her conscious state. The spasticity in the extremities slowly improved. In an attempt to hasten the improvement of her mental state, stellate ganglion blocks were started on March 8, 1949, blocking the left and right ganglia on alternate days for a total of seven blocks. This seemed to give considerable impetus to the improvement of the mental state and seemed to hasten subsidence of spasticity in the extremities. The oxygen tent was discontinued on March 8, 1949, and by March 15, she was talking and had regained memory of the accident. Speech was still somewhat slurred.

She continued to improve from this point until almost all evidence of cerebral involvement had disappeared. She is still easily disturbed emotionally, cries easily and seems to "fly off the handle" more readily than normal. All spasticity in the extremities has completely subsided and muscle coordination is normal. Because of non-union in the fractured right tibia, an open reduction and sliding bone graft was performed on April 27, 1949, using tourniquet hemostasis. Following surgery a double spica cast was applied and patient had no difficulty during her postoperative course. This patient is now ambulatory and has no swelling in the lower extremities. Certainly, the femoral vein ligation has not resulted in any abnormal swelling or interference of healing.

Discussion. It is believed that this is an excellent and typical example of cerebral or systemic type of fat embolism. As is seen in 30 per cent of the cases, especially in young, healthy individuals, there is little evidence of pulmonary involvement or impairment, although it is evident that the fat must pass through the pulmonary capillaries before reaching the systemic circulation. This case emphasizes the importance of keeping the diagnosis of fat embolism in mind and recognizing it when it occurs. It is definitely the opinion of the attending physicians in this case that this patient would have died, had the femoral vein ligations not been performed, thereby stopping the successive showers of fat emboli. Because of the high mortality of severe fat

embolism, ligation of the femoral vein or one of its two major tributaries certainly seems a justifiable procedure.

SUMMARY

A discussion of the pathogenesis, diagnosis, and treatment of fat embolism has been presented in the hope that this serious complication may be more frequently recognized and effectively treated in the future. Three case reports are presented illustrating different types of fat embolism and demonstrating the effective use of vein ligation in one case.

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THE USE OF STREPTOKINASE AND STREPTODORNASE IN INJURIES OF THE CHEST*

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THE recent management of 325 patients with war injuries of the chest has presented the opportunity to use and observe the actions of streptokinase and streptodornase (SK-SD) in 41 patients. This report deals with the use of these enzymes in clotted hemothorax, acute and chronic empyema, non-tuberculous bronchopleural fistulas, and open infected wounds of the chest wall. These agents are prepared commercially from broth cultures of certain strains of the hemolytic streptococcus. The enzymes are elaborated extracellularly by these organisms and are found in quantity in the broth filtrate. They are separated from the bacteria, sterilized by simple Seitz filtration, and the filtrate is dried and concentrated by the process of lyophilization. The dry powdered enzyme produced is stable for long periods of time. Prior to use, the enzymes are redissolved in either saline or water, and dilutions up to 10,000 units of SK and 4,000 units of SD per cc. are effective.

Tillet, Sherry, Long, Miller, and others have emphasized that although rather dramatic results are often obtained from the use of these enzymes, they should not be employed in conditions in which they are not indicated.^{1,2-8} Like all enzymes they have a definite specificity of action which limits their effectiveness to a particular substrate. Their usefulness stems from the alteration in the physical state of the substance attacked, not the chemical changes produced. The effectiveness of the enzyme mixture is dependent upon these properties. First, streptokinase will hydrolyze fibrin. Second, streptodornase will hydrolyze desoxyribose nucleoprotein.^{5,7} Third, SK-SD unmask bacteria and thereby aid in sterilization by removing the protective fibrin and nucleoprotein barriers exposing the bacteria to the action of local antibiotics. Fourth, the irritant action of SK-SD promotes the growth of granulation tissue.

CLOTTED HEMOTHORAX

Streptokinase is effective in promoting the hydrolysis of fibrin,

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changing the main constituent of a blood clot, from a solid to a liquid state. Thus its use in clotted hemothorax was early suggested.^{2,3} As a prerequisite, certain criteria must be present. It is not being elementary to state that a definite space must be present. There is reason to believe that injection into the lung parenchyma may be followed by a serious inflammatory response. Removal of the breakdown or degradation products must be accomplished promptly. If used in the closed chest, needle aspiration should be performed every 24 hours. If tube drainage, which is preferable, is employed, the enzymes and breakdown products can conveniently be removed more often, as the maximum effect of the enzyme is obtained in from 4 to 12 hours. In open wounds simple posturing for drainage 4 to 6 hours after instillation of the drug is sufficient. Additional protection against temperature elevations is obtainable by the use of the salicylates, amidopyrine, or ACTH given preoperatively. ACTH is hazardous in pulmonary tuberculosis due to the danger of lighting up a quiescent infection. Fever has not been a cause for discontinuance of treatment at this hospital.

The rapidity of dissolution of a blood clot in the pleural space is dependent on such factors as the surface area of the clot exposed to the action of the enzyme. The enzymatic and catalytic reaction takes place only at the interface between the enzyme and the clot. Thus, more rapid dissolution occurs following multiple injections of the enzymes. A new clot is more readily dissolved than an old one due to the diffusion of the enzyme through the interstices of the former. The churning action of the lungs accelerates mixing of enzyme and clotted blood and aids in dissolution. If organization has occurred, enzymatic therapy will be of little avail as the enzymes do not lyse living cells.

CASE REPORTS

CASE 1. An 18 year old soldier sustained a penetrating wound of the left chest by grenade fragments on July 12, 1950. A hemothorax resulted and repeated thoracenteses brought about little improvement. He was admitted to Fitzsimons Army Hospital on July 21, 1950 and on August 8 and August 11, 1950, streptokinase (200,000 units) and streptodornase (75,000 units) dissolved in 10 cc. of saline were injected into the left pleural space. During the 14 days following the initiation of enzyme therapy a total of 580 cc. of thin liquefied blood clot was aspirated from the pleural space. The pleural space became dry. The opacity noted on the roentgenogram cleared, the immobile diaphragm became mobile, and the vital capacity increased from 53 to 75 per cent. Bronchspirometry revealed normal lung function values bilaterally (figs. 1, 2).

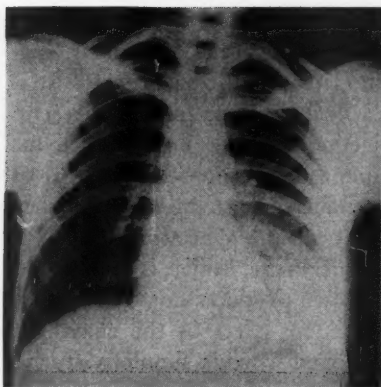


Fig. 1. Case 1. (8-3-50) Hemothorax, 21 days after injury. Repeated thoracenteses resulted in little improvement. SK-SD started 8-8-50.

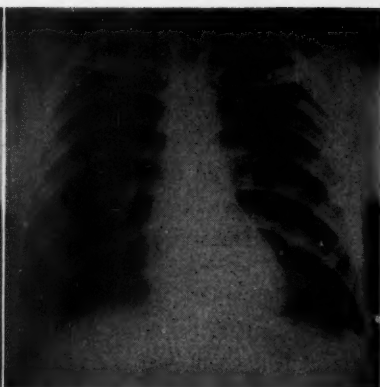


Fig. 2. Case 1. Roentgenogram six months after SK-SD therapy. Normal pulmonary function is present. Patient has been well five months.

ACUTE EMPYEMA

The two specific contributions of enzyme therapy to the problem of acute empyema are the changes produced in the physical state of the purulent exudate and the greater ease of sterilization of the pleural fluid. Streptodornase hydrolyzes desoxyribose nucleoprotein, the protein constituting the bulk of the solid sediment in a purulent exudate. The insoluble gelatinous viscid desoxyribose nucleoprotein is hydrolyzed and soluble nucleic acid and the purine and pyrimidine bases are formed. Whereas, before institution of enzyme therapy, aspirations are often difficult and productive of only small amounts of thick empyema fluid, after therapy, aspirations are easily performed as the empyema fluid is thin and watery.⁸

As a result of the lysis of fibrin and desoxyribose nucleoprotein, the bacteria are shorn of this protective barrier, exposing them to the action of locally instilled antibiotics. After enzyme therapy, cultures of the removed pleural fluid may become positive; whereas, the fluid before enzyme therapy had been negative for a long period of time. This represents the unmasking or the release of bacteria previously encapsulated in fibrin and nucleoprotein and does not represent a failure of the enzymes and the locally instilled antibiotics.

Studies at this hospital have shown that streptokinase and streptodornase may be combined effectively with the sulfonamides, penicillin, streptomycin, aureomycin, and chloromycetin without inhibition of the action of either. One is so often impressed with the speed with which a local sterility is produced that synergism is

suggested. By culture plate methods, true synergism does not exist, but mechanically a more favorable situation is produced in vivo when enzymes and antibiotics are used simultaneously.

CASE 2. A 21 year old soldier was wounded on Aug. 28, 1950, suffering from a penetrating wound of the abdomen and a left hemothorax. The perforated ileum and large bowel were sutured and a proximal colostomy performed. The hemothorax was treated by repeated thoracentesis. The patient was admitted to Fitzsimons Army Hospital on Sept. 24, 1950. On Oct. 3, 1950 he developed a *B. coli* empyema and SK-SD therapy was begun on Oct. 19, 1950. The fluid rapidly became thinner and easier to aspirate. A total of 1015 cc. of purulent fluid was removed during the following 22 days. Cultures were sterile after 19 days. Chest roentgenograms showed clearing of the opacity in 23 days. It is felt that SK-SD through hastening sterilization and promoting ease of aspiration aided materially in clearing this empyema and preventing chronicity (fig. 3, 4).

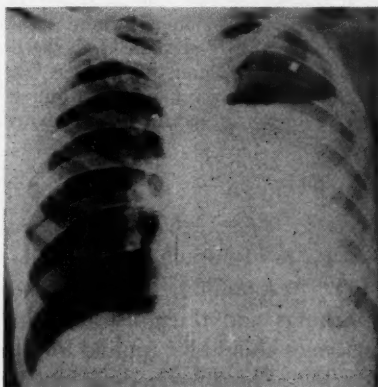


Fig. 3. Case 2. Roentgenogram of 15 day old empyema. SK-SD begun following day. Metallic foreign body lies in shoulder girdle.

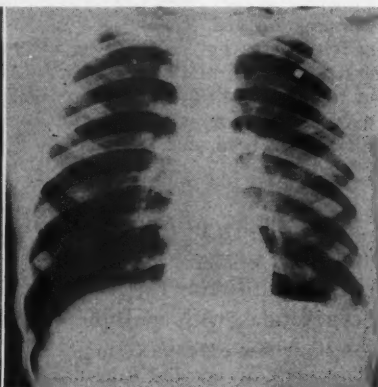


Fig. 4. Case 2. Roentgenogram 24 days later showing complete clearing.

CHRONIC EMPYEMA

The objective of enzyme therapy in chronic empyema differs from the objective in acute empyema. The aim here is not cure of the empyema but rather to aid in sterilization and the use of the enzymes should not alter the fundamental concept of surgical requirements. Pulmonary decortication in empyema has been a decided improvement and decortication is performed promptly once an increased degree of sterility is obtained. Continued use of the enzymes beyond this point in an attempt to lyse the thick fibrous wall of a chronic empyema pocket results only in failure.⁹ It must be recalled that SK-SD lyse only fibrin and desoxyribose nucleoprotein. They are not collagenases. The wall of an empyema

pocket once invaded by angioblasts and fibroblasts must be removed surgically, not enzymatically.

CASE 3. A 21 year old soldier was wounded on Sept. 1, 1950 in the right thorax by shell fragments and a massive empyema developed. Upon admission to Fitzsimons on Sept. 24, 1950 he was toxic, temperature was 104 F., cultures of the very thick pus were positive for *Aerobacter aerogenes*. Streptokinase (250,000 units) and streptodornase (200,000 units) were injected intrapleurally on Sept. 27, 1950, Oct. 1, 1950, and Oct. 5, 1950. During the 29 days following institution of enzyme therapy, 3505 cc. of purulent material was removed from the right pleural space. The roentgenogram of the chest which upon admission showed no visible aerated lung tissue changed to that of 75 per cent reexpansion and the vital capacity increased from 58 per cent to 75 per cent. The cultures became and remained sterile after the twenty-third day of therapy. Toxicity and fever disappeared. On Oct. 25, 1950, 30 days after institution of SK-SD therapy, decortication of the residual sterile empyema pocket was performed. Postoperative course was uneventful. Function studies before discharge showed 60 per cent of the total oxygen consumption and 59 per cent of the ventilation to be on the right. This patient might have made a satisfactory recovery without SK-SD, however our observation indicated that his course was shortened and that therapy was of further benefit in that primary wound healing occurred and normal pulmonary function resulted. Wound healing has been appreciably better when SK-SD has been used.

BRONCHOPLEURAL FISTULAS

The ability of SK-SD to stimulate granulation tissue has been used with success in preparing certain types of nontuberculous bronchopleural fistulas for surgical closure. Responding favorably have been fistulas with multiple small openings and those fistulas with long narrow external tracts. The enzymes should be applied locally in the form of moistened gauze packs. The surrounding wound becomes cleaner, granulations appear, and edematous narrowing of the smaller openings may occlude the fistula in 24 to 48 hours. A favorable situation is thus produced for healing when muscle-plasty or other plastic procedures are performed. When a long external tract is present, secondary surgical closure may be unnecessary. Granulation tissue may seal the fistula with early and permanent closure. One bronchopleural fistula which had persisted for 156 days closed permanently after only two days of enzyme therapy. However, the use of SK-SD in bronchopleural fistulas is not without danger. Aspiration of the mixture into the alveolar spaces has on two occasions resulted in a severe pneumonia in the opposite lung. One must constantly look for the small bronchopleural fistula that may open up with enzymatic debridement. Pooling of the enzymes in cases of known bronchopleural fistula is prevented by their use as a moist dressing.

CASE 4. A 19 year old soldier sustained a penetrating wound of the right upper chest on Sept. 28, 1950. The lung was collapsed by a hemothorax. Subsequent decortication was unsuccessful in securing reexpansion and an empyema developed. The patient was admitted to Fitzsimons Army Hospital on Dec. 3, 1951, where a second decortication was likewise unsuccessful. SK-SD therapy was instituted by catheter lavage of the empyema pocket. On the second day of therapy the temperature rose to 102 F. and physical and roentgenographic examination suggested a pneumonic process in the contralateral mid-lung field (fig. 5). Clearing of the pneumonitis occurred rapidly on discontinuing SK-SD and subsequent bronchographic studies revealed the previously unsuspected bronchopleural fistula.

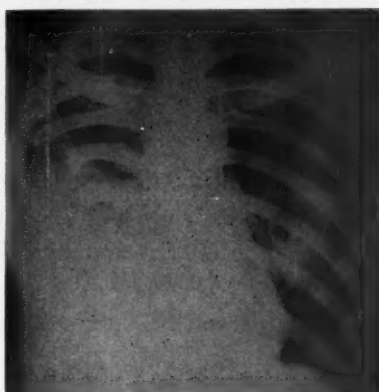


Fig. 5. Case 4. Roentgenogram showing chemical pneumonia of left lung, secondary to aspiration of SK-SD.

Because of this case and a similar one, we are reluctant to use the enzymes in widely patent bronchopleural fistulas or in cases where one can not be certain of the pleural space. Injection of the enzymes into the lung parenchyma, we believe, would likewise result in a severe pneumonitis.

OPEN WOUNDS

As previously mentioned the enzyme mixtures have the ability to stimulate the growth of profuse healthy granulation tissue. This action combined with the sterilization which results from the use of the enzyme and the appropriate antibiotic finds clinical use in treating recent and old infected wounds of the soft tissues.¹ In a recently infected wound the wound may be prepared more rapidly for early delayed closure. This concept is of great importance in traumatic surgery where delayed closure is often preferred. The use of the enzymes in fresh wounds has not resulted in bleeding from the dissolution of the blood clots in the contiguous vessels. The clots are intravascular, thus being well protected from the action of the enzymes.

In the chronic, slowly healing, open infected wound the drug finds its greatest usefulness. Again we must emphasize that the enzymes do not lyse fibrous tissue and that trypsin, a proteolytic enzyme found in slough, will inactivate SK-SD. Thus, preliminary adequate surgical debridement is necessary before the enzyme will become effective. Application of the enzymes to the open wound is best made by frequent use of moist packs. Strengths of 10,000 units of SK and 4,000 units of SD per cc. of diluent are used. The diluent is often a stock solution of the appropriate antibiotic. The contact period should be from four to six hours. Treatments are repeated at twice daily intervals. Treatments more frequent than this seem to have no advantage. On this routine healthy granulations have filled spaces approximately 250 cc. in a period of one week.

SUMMARY

The clinical application of the enzymes, Streptokinase and Streptodornase, relative to certain injuries and conditions affecting the pleural space or chest wall have been described.

The specific expectations from their use as well as contraindications have been listed.

It is recognized that many cases will proceed to recovery without use of the enzymes. It is the opinion of the authors that used as an adjunct to surgery the enzymes are definitely beneficial. Aspiration of semi-clotted or purulent collections is made easier and more successful. Sterilization of infected material is hastened. Contaminated wounds may be prepared more rapidly for closure and with a higher percentage of healing without complications.

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BLADDER SUBSTITUTION WITH ISOLATED SMALL INTESTINE SEGMENTS

A Progress Report

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TWO main factors have contributed to the interest in bladder substitution in the past five years. First, the discovery that a high percentage of patients with ureterosigmoidal anastomosis into an intact bowel develop blood chemistry imbalance resulting from chloride absorption from the urine.⁸ Second, the growth of pelvic evisceration as a therapeutic procedure which requires transplantation of both ureters in the absence of the rectum and sigmoid colon.⁶

In searching for a method of bladder substitution it is important to keep in mind certain basic objectives. There is always the chance that the patient's longevity may be determined by the method of ureteral transfer. This, of course, will depend on the curability of the primary lesion, but each substitution should be accomplished as if the primary lesion were cured. The method of substitution selected should provide for the comfort and convenience of the patient. When associated with pelvic evisceration, the substitution procedure should provide for short and simple technical execution, since it is only an incidental part of the operation. Finally, the bladder substitute must offer a low incidence of ascending infection and of electrolyte imbalance from absorption of urinary constituents. The method of substitution that appears to us most nearly to meet these objectives is the use of a short segment of terminal ileum to act as a means of transporting the urinary stream from the ureters to a single abdominal stoma which is conveniently located for the application of a Rutzen bag (fig. 1). The purpose of this paper is to present the technical developments and an analysis of the early results observed in 25 bladder substitution procedures done by this method since April 1950.

Hinman and Weyrauch¹⁰ have supplied an excellent summary of the various methods of bladder substitution attempted in the past. Recent additions to the literature of this subject include the reported experimental work of Bisgard^{2,3} in which he substituted a segment of sigmoid colon for the urinary bladder in dogs. The procedure was done in stages and the segment was evacuated through the

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intact urethra. Appleby,¹ who appears to have been the first to complete successfully the procedure of pelvic evisceration, reported the transplantation of both ureters to the intact terminal ileum to drain



Fig. 1. Patient L. R. Bladder substitution following pelvic evisceration. Bladder substitute and kidney pelvises visualized by the injection of a thin barium mixture into the isolated small intestinal segment. This segment empties into a Rutzen bag through the anterior abdominal wall midway between the umbilicus and anterior superior iliac spine.

through a sigmoid colostomy. One seven-year survivor of this procedure was listed. Gilchrist⁹ has attacked the problem by using the isolated cecum as an intra-abdominal reservoir to be drained through a short segment of terminal ileum. It was the feeling that this procedure could lead to the development of continence and had the additional advantage of placing the ureteral anastomoses in such a position that they were accessible to cystoscopic visualization and instrumentation. Bricker and Eiseman⁶ reported the use of terminal ileum and cecum as a bladder substitute following pelvic evisceration and indicated failure of attempts to provide a continent external stoma. Parsons¹¹ has reported on the transplantation of the ureters to the intact colon following pelvic evisceration and lists the operative complications. The preliminary report of the use of short segments of terminal ileum as a bladder substitute appeared in October 1950.⁴

Much of the previous work on bladder substitution has been influenced by a desire to develop continence. The efforts of Gilchrist in this regard are of interest and deserve further investigation. However, our own brief experience indicates that the ileocolic valve

cannot be relied upon for continence and the cecal "pouch" is continent only until it is filled to capacity. With the development of the various types of ileostomy bags that glue to the skin, we have been afforded an opportunity to forget about developing continent intra-abdominal bladder substitutes and to direct our energies more profitably toward other facets of the problem.

TECHNIC

The technic of our procedure has changed little since the preliminary report in October 1950.⁴ A 6 to 8 inch segment of ileum is isolated with its blood supply carefully preserved. The distal end of this segment is usually located about 6 inches from the ileocecal junction. An end to end anastomosis of the remaining ileum is done with two rows of fine interrupted cotton or silk. The proximal end of the isolated segment is closed, the ureters are anastomosed to it, and the distal end is brought out through an accessory incision to the right of the umbilicus. Great care is used for the uretero-intestinal anastomosis, a meticulous end to side, mucosa to mucosa, two layer anastomosis with fine interrupted, nonabsorbable sutures being done. No ureteral catheters or anastomotic splints are used. We no longer close the right lateral gutter since we have decided that the danger of intestinal obstruction from herniation through this large aperture is negligible. On the other hand, we now are careful to tack the left ureter to the under surface of the mesentery in order to reduce the hazard of intestinal obstruction. It is considered of importance to make sure that the bowel segment is decompressed in the early postoperative period. This is accomplished by inserting a catheter into the segment through the abdominal stoma, the mucosa of which is carefully sutured to the edge of the skin incision for primary healing. This catheter is removed on the third or fourth postoperative day and a Rutzen bag is applied to the stoma. In those few patients for whom bladder substitutes have been made as palliative procedures without pelvic evisceration, a rubber-dam drain has been inserted into the cul-de-sac in case there should be a leak of urine from one of the anastomoses. In the cases of pelvic evisceration the perineal drain is considered adequate to take care of this contingency.

MATERIAL

The complexities of the problem of bladder substitution make it seem advisable to divide its evaluation into two phases. First, an analysis of the complications and functional results that are associated with the operative procedure itself and the early postopera-

tive period. Second, an analysis of the functional results in those patients having gone long enough for the development of late complications. This report will be confined to the first phase and represents a study of the early results and complications in 25 patients having bladder substitution by this method. In 21 patients the procedure was associated with pelvic evisceration for carcinoma. In 4 patients the procedure was palliative and was done alone or in conjunction with simple sigmoid colostomy. For each patient the period of the study covers the time from date of operation to date of discharge from the hospital. The late complications of hydronephrosis and infection will require a larger series of cases and a longer period of time for proper evaluation. Four patients who did not survive the procedure of pelvic evisceration are not included in this study. In none of the 4 patients could death be attributed to the bladder substitution per se.

RESULTS

Table I indicates the complications encountered in this group of patients.

TABLE I
Early Complications

Number of Bladder Substitutions followed.....	25
COMPLICATIONS	
Intestinal Obstruction	2
Anuria	1
Pyelonephritis	1 (expired)
Hydronephrosis	1
Hyperchloremia and Acidosis	0
Azotemia	0
Fecal Fistula	0
Urinary Fistula	0
DEATHS attributable to Bladder Substitution...	1 (Pyelonephritis)

Mortality. The one death was directly attributable to bilateral severe pyelonephritis. The case was one of pelvic evisceration for postirradiation recurrent carcinoma of the cervix associated with bilateral hydronephrosis before operation. We have thus far not resorted to nephrostomy preoperatively except in 1 case of total anuria (fig. 2). It is possible that bilateral preoperative nephrostomy might have contributed to a successful outcome in this fatal case. Figure 3 shows the enormously dilated kidney pelves. Both anastomoses were widely open and the kidneys were completely decompressed, yet there was a virulent *Proteus vulgaris* infection

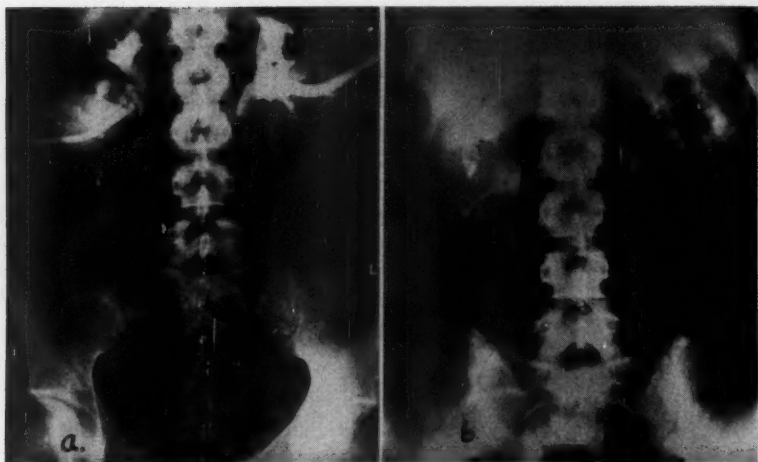


Fig. 2. Patient R. A. S. Admitted to hospital completely anuric from bilateral ureteral obstruction. (a) Bilateral nephrostomy done as an emergency procedure. Subsequent pelvic evisceration and bladder substitution with an isolated small intestinal segment. (b) Renal status two weeks after bladder substitution and following removal of the nephrostomy tubes.

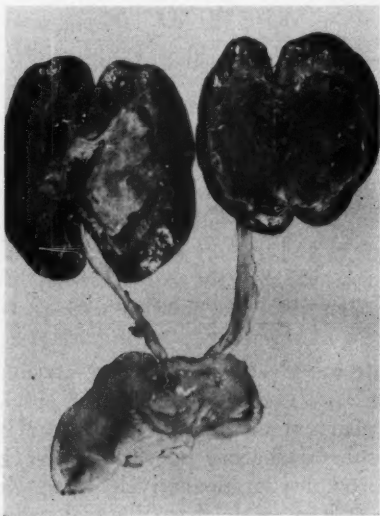


Fig. 3. Patient B. P. This patient presented bilateral hydronephrosis of extreme degree before operation. Death on the twenty-eighth postoperative day was due to ascending infection and diffuse pyelonephritis in spite of widely patent ureterointestinal anastomoses which can be visualized in the photograph. Postmortem cultures of the kidney pelves revealed a pure growth of *Proteus vulgaris*.

with multiple small parenchymal abscesses. This patient died on the twenty-eighth postoperative day.

Intestinal obstruction. Because the procedure, as employed by us, entails anastomosing the ureters within the peritoneal cavity and providing an external opening for the isolated ileal segment, the hazard of small bowel obstruction is obviously increased. In addition there is an end to end anastomosis of the remaining ileum. All patients are carefully watched during the postoperative period for signs of intestinal obstruction. This complication has appeared only twice. One patient was relieved by simple decompression without surgical interference. The other had a loop of bowel obstructed deep in the pelvis which was relieved quite simply by manipulation through the perineal defect. If this complication is recognized early it can usually be minimized by prompt intestinal intubation. Considering the nature of the procedure it is surprising that intestinal obstruction has not been seen more frequently.

Anuria. There have been no instances of lower nephron nephrosis recognized. Without exception the urinary output has been prompt in appearing and adequate in amount. The one instance of anuria listed occurred transiently 48 hours after operation and after the patient had been excreting adequate quantities of urine. Urine flow reappeared 24 hours later. It is assumed that this phenomenon represented temporary obstruction at the ureterointestinal anastomoses from edema. Figure 4 illustrates a case in which the subsequent resolution of early postoperative hydronephrosis led to the interpretation that edema at the site of anastomosis was the causative factor. It has been impractical to measure the urinary output accurately in the first three or four postoperative days. A catheter placed in the isolated segment to keep it decompressed collects only part of the urinary output, the remainder escaping around the catheter into the dressing. A Rutzen bag is applied on the third or fourth postoperative day.

Pyelonephritis. It is impossible to determine with certainty in the early postoperative period whether or not ascending urinary tract infection has occurred. Those patients having pelvic evisceration always have some degree of temperature elevation. Antibiotics are always used prophylactically and probably mask some urinary tract infections that will not become apparent until later. It is for this reason that the studies pertaining to infection should not be evaluated until sufficient time has elapsed for this complication to occur. A period of six months should be considered a minimum for this purpose. The one complication here reported is included because of its obvious and virulent nature, and because of its fatal termina-

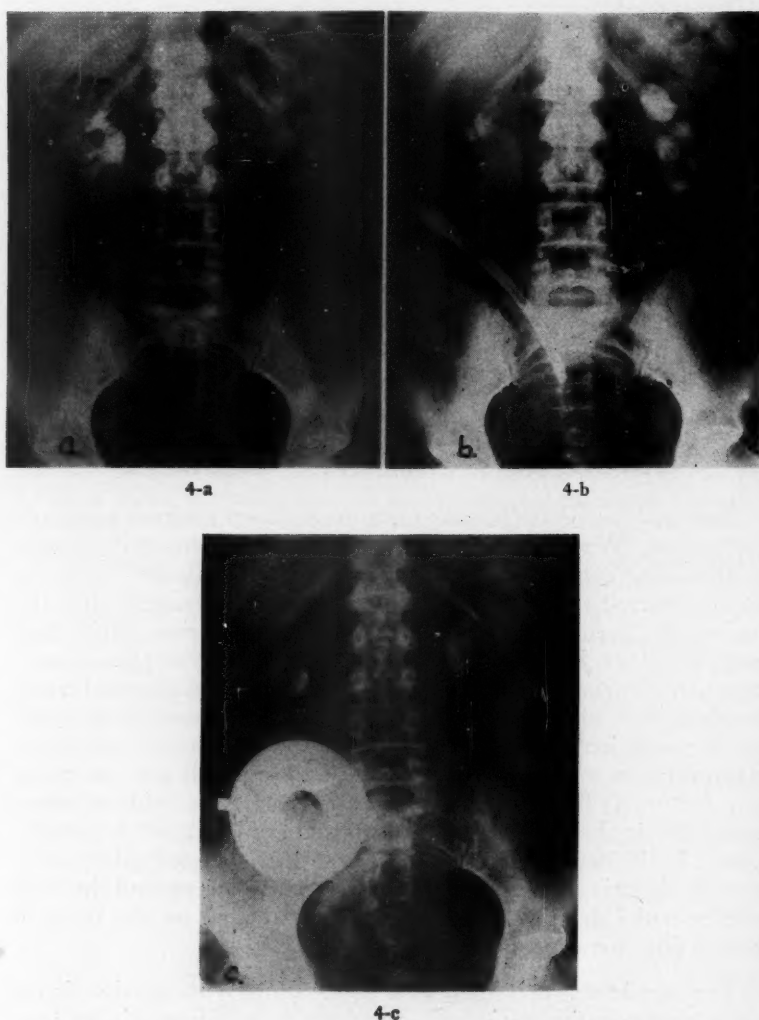


Fig. 4. Patient J. S. This case illustrates the mild degree of hydronephrosis that is frequently present two weeks following bladder substitution. (a) Pre-operative renal status. (b) Pyelograms two weeks following bladder substitution. The right renal pelvis at this time shows dilatation with blunting of the calyces. The left pelvis still shows evidence of hydronephrosis, though less than preceding operation. (c) The renal status six months following bladder substitution at which time both the right and left pelves are within normal limits.

tion before the patient was discharged from the hospital (fig. 2). Other instances of pyelonephritis have subsequently appeared and will form the basis for a detailed study of this complication.

Hydronephrosis. This complication, like that of infection with which it is so intimately associated, can be evaluated accurately only by long term observation. Intravenous pyelograms are made routinely two weeks following bladder substitution. Minimal hydronephrosis is frequently present. Subsequent studies may reveal this to be stationary, progressive, or to have completely disappeared. Again, unless a given case appears to be markedly progressive, six months should be a minimum time before final evaluation. The two weeks pyelogram is made to be sure that both kidney pelves are emptying adequately to justify discharge of the patient. The 1 patient listed as having hydronephrosis is the only one that at two weeks showed such a degree of obstruction that loss of kidney function was anticipated (fig. 5). Subsequent follow-up revealed the hydronephrosis and loss of function to be progressive and complicated by the appearance of infection. Four months after bladder substitution we operated on her again, revised the ileum segment and reanastomosed the dilated ureters. The early appearance of hydronephrosis in this case was an indication of the subsequent clinical problem. This is the only case of the series thus far presenting evidence of this complication in the early postoperative period.

Hyperchloremia and acidosis. In none of the patients studied has there been evidence of hyperchloremia and acidosis. Work not yet published indicates that absorption of chloride through these short segments is negligible and subject to controllable factors, one of which is the length of the segment used.⁷

Azotemia. In a few instances the nonprotein-nitrogen has undergone transient slight elevations following the operation. These have been considered as due to factors other than absorption of nitrogenous waste products through the intestinal mucosa. In all instances the nonprotein-nitrogen levels were normal at the time of discharge from the hospital.

Fecal fistula. Parsons¹¹ reports fecal and urinary fistulas as being rather frequent complications of ureterocolostomy. It is apparent that by transplanting the ureters to an isolated segment of bowel the incidence of fecal fistula will be greatly reduced. We have had no such complication. The end to end ileal anastomosis, a potential source of this complication, is controlled completely by assuring the vascularity of the bowel ends, and by a meticulous two layer anastomosis with nonabsorbable interrupted sutures.

Urinary fistula. This complication has been eliminated by the type of ureterointestinal anastomosis and by isolating the bowel segment and keeping it completely decompressed with an indwelling catheter during the early postoperative period.

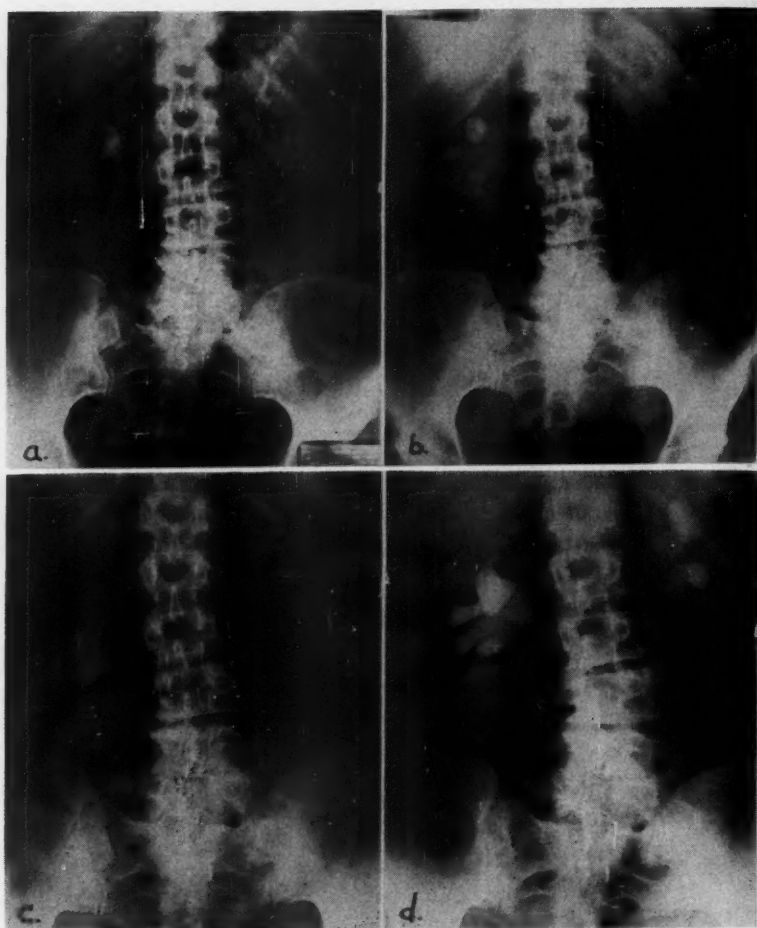


Fig. 5. Patient G. H. This series of pyelograms illustrates the progression of hydronephrosis which was indicated by the pyelograms made two weeks following bladder substitution. (b) The preoperative pyelograms (a) were normal. (c) One month later there was evidence of progression of the hydronephrosis rather than regression. Four months from the date of operation (d) the evidence of hydronephrosis and progressive kidney damage was so strong that reoperation was considered necessary for revision of the anastomoses. This is the first patient of the series in which such a procedure has been done and the only patient to show this marked degree of ureteral obstruction in the two-week post-operative films.

DISCUSSION

It would appear that the early complications of bladder substitution with isolated segments of ileum will be of such a minor nature that they will not seriously contraindicate the procedure. By this

method the distressing and discouraging complications of fecal and urinary fistulas should be eliminated. Intestinal obstruction will undoubtedly occur more frequently following these complicated and involved procedures than following other types of abdominal surgery. The danger can be minimized by prompt recognition and aggressive treatment. If the factors contributing to lower nephron nephrosis are controlled adequately, anuria is likely to occur only from obstruction at the anastomosis. Hydronephrosis and its sequel, pyelonephritis, are also secondary to obstruction at the anastomosis. It is therefore obvious that the anastomosis is a vitally important step in the procedure. It is our opinion, not yet verified, that the careful end to side, mucosa to mucosa anastomosis of the ureters to an isolated segment of small bowel will result in a decreased incidence of hydronephrosis and ascending infection.

Patients who have undergone bladder substitution by this method are pleased with the ease with which they can take care of themselves. The Rutzen bag is changed once every 24 hours, and in some instances less often. Those patients having had pelvic evisceration have a sigmoid colostomy which functions normally. In our opinion this solution to the problem of bladder substitution is most satisfactory. Whether it will have appreciable advantages over other methods, including the "wet" colostomy and skin ureterostomies, remains to be seen. It is safe to predict that the procedure proved by time to be preferable, will be the procedure resulting in the lowest incidence of hydronephrosis and pyelonephritis and at the same time providing for correction and control of these complications, when they occur, by reoperation or by instrumental manipulation.

SUMMARY

The early postoperative complications resulting in 25 cases of bladder substitution with isolated segments of small intestine are presented. Factors contributing to the cause and to the prevention of these complications are discussed.

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PULMONARY ADENOMATOSIS AND ITS RELATIONSHIP TO THE PROBLEM OF MALIGNANT TUMORS OF THE LUNG

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Nature of process

OF CONSIDERABLE current interest, human pulmonary adenomatosis is not without curious and speculative features, because of the many questions that the disease poses. For this reason, pulmonary adenomatosis has been of interest primarily to the pathologist because of the following questions:

1. Is this an infectious disease?
2. What is its relationship to jaagsiekte (pulmonary adenomatosis in sheep)?
3. From whence do the adenomatous cells arise?
4. Is the process benign, hyperplastic, or only a variety of so-called alveolar cell tumors?

There has been a great deal of discussion as to the relationship of jaagsiekte to the human disease. Jaagsiekte is a pulmonary adenomatosis in sheep which is considered by most investigators to be a virus infection. The disease is transmitted among sheep very easily by placing a healthy sheep with the diseased ones.

Anatomical considerations

The morphologic resemblance of pulmonary adenomatosis in sheep to certain cases of pulmonary adenomatosis in man was first described by Bonne in 1939. His observations were the primary factor in the stimulation of renewed interest in this disease. All subsequent investigators have noted the morphological similarity as primarily noted by him. Efforts to isolate a virus from the human specimen of pulmonary adenomatosis and transmit the condition to animals have been unsuccessful. Evidence, however, seems to indicate pulmonary adenomatosis as a specific response to certain non-specific irritants. Evidence and opinion favor nonciliated cuboidal or columnar cells lining otherwise unaffected alveolar walls to characterize the microscopic changes. The hyperplastic type sometimes presents a papillary distribution. The cells may have an eosinophilic granular cytoplasm, and there may be goblet formation with a brush

border. The nuclei are usually basal or subcentrally located. Mitotic figures are uncommon. The microscopic features are fairly identical with those of the alveolar cell carcinoma. The main differential is probably the nonmetastasizing nature of the disease. The gross pathology usually resembles pneumonia in the gray hepatization phase. It has been suggested by Swann that the term adenomatosis be used to describe the disease in those cases which fulfill the following criteria: (1) alveolar, cellular proliferations characterized by the appearance of tall columnar mucus producing cells, (2) absence of an intrinsic tumor of the bronchial tree, and (3) absence of primary adenocarcinoma of any other part of the body.

Age and sex

With exception of the cases collected by the Army Institute of Pathology, there have been 17 reported cases in women and 6 cases observed in men; our 2 makes a total of 8. The sex incidence of 2 women to every man is very interesting when the incidence of bronchogenic carcinoma in man is considered. The average age of all patients is about 54 years. The average duration of the disease is from several weeks to several years, although this cannot be accurately determined. The relative incidence of pulmonary adenomatosis occurring in the group of lung tumors is about 5 per cent. Metastasizing alveolar cell carcinoma also occurs at about 5 per cent.

Clinical considerations

Until recently a clinical diagnosis has not been made except in a few instances where the diagnosis has been based on surgical specimens. Unfortunately there are no pathognomonic signs of pulmonary adenomatosis. Patients usually give no history of exposure to sheep. Radiologically the disease must be differentiated between fungus infection, Boeck's sarcoid, carcinoma, or tuberculosis. There are prominent presenting inaugural complaints. A chronic cough which is productive of large amounts of frothy, tenacious, mucoid sputum, presents itself. Emphasis is placed on this observation because this type and amount of sputum are probably characteristic of the disease. Dyspnea, which is all out of proportion to the cough and sputum, appears early in the disease. These patients probably die from the mechanical interference with the gaseous exchange in the lungs, resulting from the investment of the alveoli with the adenomatous cells and copious exudate. Hemoptysis is rare in this disease and its absence appears to be a rather characteristic feature.

CASE REPORT

This patient was a 40 year old white male admitted to the hospital as a diagnostic chest problem. History of his present illness dated back approximately two years prior to admission, at which time he began to notice dyspnea on exertion, fatigue, and cough which was productive of large amounts of mucoid sputum. In that interval of time his symptoms gradually worsened. Numerous chest roentgenograms revealed bizarre, progressive, bilateral lesions. Previous skin tests for TBC, coccidioidin, histoplasmosis, and fungus were negative. Other laboratory data were within normal limits.

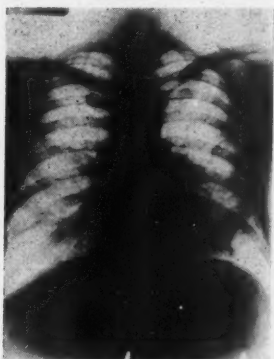


Fig. 1. X-ray showing a rather diffuse nodular process throughout both lung fields.

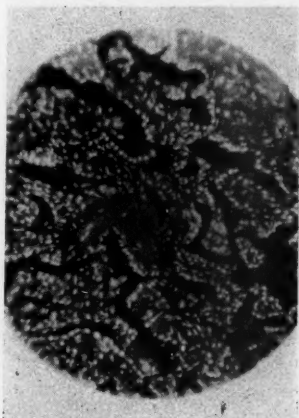


Fig. 2. Photomicrograph showing the papillary arrangement of the hyperplastic type.

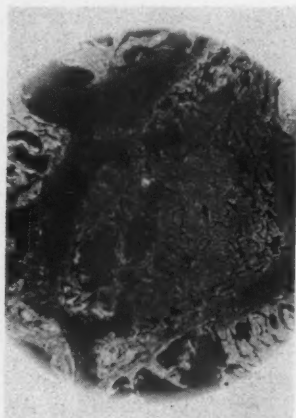


Fig. 3. Photomicrograph showing an alveolus filled by hyperplastic cuboidal cells with an otherwise unaffected wall.

Pertinent physical findings were as follows: crackling rales over both lung fields, slightly more marked on the left, were noted; there was a marked clubbing of fingers and toes.

Bronchograms which were performed were reported as normal. Diagnostic bronchoscopy was carried out and bronchial washings performed. These were reported as negative for fungi, tumor cells, and AFB. Following this, an exploratory thoracotomy was done with segmental wedge resection of several of the nodular areas, and a diagnosis of pulmonary adenomatosis established (figs. 1, 2, and 3).



Fig. 4. X-ray showing a unilateral nodular process involving the left lung.

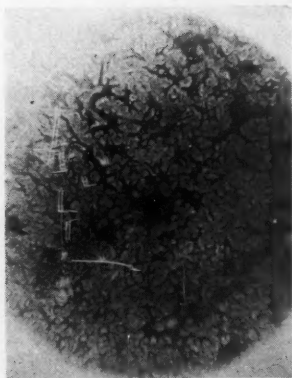


Fig. 5. Photomicrograph showing the same papillary arrangement as seen in pulmonary adenomatosis.

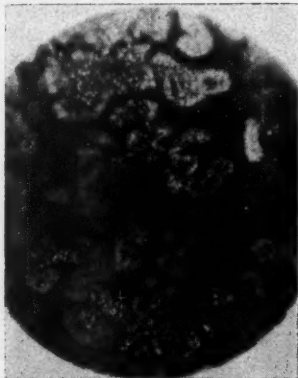


Fig. 6. Photomicrograph of a high power view showing the rather characteristic signet ring cells of alveolar cell carcinoma.

CASE REPORT

For the purpose of contrast and comparison, I wish to show this case of alveolar cell carcinoma in a 54 year old male. His presenting complaint was persistent hemoptysis of several months' duration.

Bronchoscopy was negative and bronchial washings were not performed at that time. Exploratory thoracotomy and pneumonectomy were carried out and diagnosis of alveolar cell carcinoma established (figs. 4, 5 and 6).

SUMMARY

Pulmonary adenomatosis is a rare disease in man. The lung is involved in an adenomatous process in which the alveoli are filled with hyperplastic or mucus-filled columnar cells. The nature of the disease has been considered. Even though there are no pathognomonic signs of pulmonary adenomatosis, it is felt that the dyspnea; abundant, frothy, mucoid sputum without hemoptysis; progressive downhill course over several months; and death due to asphyxiation should be considered as important clinical features. The resemblance of adenomatosis of the lung to alveolar cell carcinoma is striking in all respects.

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UTERINE SUSPENSION INDICATIONS AND STATUS

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MALPOSITIONS of the uterus and, in particular, retroversion has excited the interest of gynecologists and surgeons for many years but in the last two or three decades there has arisen considerable doubt as to its significance. There have been about 150 different operative procedures and 300 mechanical devices suggested to correct retroversion.³ This alone would lead to some doubt as to the efficacy of any one or all of the procedures. It has been estimated that one in five of all women have a retroverted uterus and multiple symptoms have been attributed to this condition. Because any one of the surgical procedures offers little technical difficulty, the condition occurs frequently and many symptoms have been and still are attributed to it, the retroverted uterus has lent itself well to abuse. While the theory upon which these operations were based has been obsolete for over a generation, the correction of the condition in many hospitals still remains a popular and frequent operation.

In reviewing the literature on the subject of correction of the retroverted uterus, there is a paucity of information from which one can gain a concept of the value of the procedure. Telinde's textbook of gynecology offers a very conservative and open minded viewpoint of the procedure and the few conditions in which it is indicated. In reviewing the operative work done in a medium sized general hospital for another purpose, it was noted that there seemed to be an overabundance of uterine suspensions, apparently a primary procedure in most instances with little associated pelvic pathology. The author has had the experience of spending one year on a university gynecological service and had never seen the procedure done. For this reason it was decided to query the heads of Departments of Obstetrics and Gynecology of the medical schools of this country and several of the private clinics where the caliber of work done was unquestionably good. Fifty replies were received and are used as a basis of condemning the abuse of the procedure as seen in three mid-western hospitals in urban communities. All are open staffed hospitals, well equipped and well administered but there has been an apparent lack in control of the type of surgery performed as indicated by the frequency of uterine suspensions. Three other hospitals were requested to furnish statistical information in order to gain a sampling of several areas but the informa-

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tion was not received. In all probability the same situation exists in most communities of the size that was studied.

It is hoped that the information obtained in this study will offer a clearer concept as to the general attitude toward uterine suspensions and further will show that many of the ideas of a generation ago are obsolete and the procedure has only limited use in indicated pathology. As has been stated by Ravdin⁵: "It is time we became frank about the rape of the pelvis." He has very brilliantly set forth a modern philosophy of the attitude of the physician toward the patient. He states that in these times when medicine is being attacked, surgeons are unfortunately furnishing a good portion of the ammunition. We can no longer adopt the attitude of live and let live. We have a very definite responsibility to assure our patients that they will receive the best of medical and surgical care. In doing this we must face issues with candor and honesty and when things are not right in our professional services of a hospital we have a duty to correct them and not seek to avoid them. Perhaps they will never be perfect but it should not be due to a lack of energetic effort on our part. Uterine suspensions as such are but a small segment of some of the defects that are in need of revision. It is hoped that this study will also serve the purpose of reawakening hospital staffs to their responsibilities. We speak of our relations with the public and our national medical society has hired professional people to improve our relations. We could very well begin by improving these relations locally by stimulating better professional care to the best of our abilities. Derelictions of a few have brought discredit to the whole. If we are united for good we should by the same token be united against bad, and we must admit that there is bad and where possible it should be stamped out. When a non-calculous gallbladder is removed for minimal symptoms, and in the majority of instances no improvement of the patient's condition, there is a small segment of our population acquainted with this individual who receive a very bad impression of the procedure. Many times this has led to the deferment of surgery by individuals who would really benefit by surgery but refuse because their neighbor was unrelieved by the same procedure. The wholesale use of uterine suspension is not good and it is our duty as honest physicians to admit it.

The most common explanation for the occurrence of a retroverted uterus which has already been stated to be present in about 20 per cent of all women, is congenitally short uterosacral ligaments or those made inadequate by childbirth. It is generally believed that the cardinal ligaments serve to hold the cervix in its vertical plane and that the round ligaments act as guide ropes to

steady the uterus in labor although in the latter situation many observers feel that the round ligaments have a real part in forming the axis of the uterus. Intra-abdominal pressure acts to hold the uterus in the plane that has been established by its ligamentous attachments.

In most instances the position of the uterus gives rise to no symptoms,⁶ and in another large group the symptoms are not a justification for a suspension operation. It has been theorized that retroversion of the uterus is a cause of degeneration of the ovaries. TeLinde states that he has never observed this phenomenon. He feels that this opinion plus a desire to operate has led to many needless operations and that the practice continues today. Uteri that are suspended for symptoms such as dyspareunia, bearing down feeling, frequency of urination, various menstrual disorders, dysmenorrhea, nervousness, constipation and in most instances of backache, have been needlessly done and the symptoms instead of being relieved are many times exaggerated.

The question that was asked of the authorities in this report was, "Would you please give a brief and concise opinion as to the indications, if any, for a suspension of the uterus?" The answers were in the main conservative and the majority felt that the operation had merit in certain gynecological conditions but that these were rare and no one group performed many suspensions. There were quite a number who were very adamant in their opinion that there were no indications at all for the procedure. These are the conditions in which the majority felt that the operation was of value although not all were agreed on some of the indications. For example, the question of sterility. A very few felt that when all other methods had been exhausted there was the rare instance where the procedure had been used successfully. Another questionable indication was repeated abortion after 10 weeks' gestation when there had been one viable child. All who felt there were indications for the procedure used it in conservative operations for pelvic endometriosis. Also there was a unanimity of opinion that in pelvic discomfort relieved by a trial of pessary for three to six months the procedure would be of benefit. These then as listed, were the only conditions in which the operation was felt to be of value:

1. In all cases of conservative operations for endometriosis where retroversion occurred.
2. In almost all instances that pelvic discomfort was relieved by a trial of pessary for three to six months.
3. In rare instances of sterility.

4. In rare instances of repeated abortion.

5. In a few instances where presacral neurectomy was done for primary dysmenorrhea and there was a concomitant retroversion.

These have been some of the typical comments of the 50 questionnaires received. The sample statements have been chosen from those with the most conservative to those with the most radical opinion, this term radical being used rather loosely, of the value of uterine suspension:

"In this department it is rarely done. In 1700 gynecologic operations a year we do about 12." (This is a large teaching hospital of an eastern university. This was more suspensions than was reported from any other institution.)

"Those of us who teach and have a private practice have abandoned suspension operations. We feel that any suspension operation terminates in failure because of the stretching of the tissues concerned. Many of the older men on the staff who formerly did the procedure frequently are becoming very conservative in its use."

"In the past two years none have been done as a primary procedure. In a rare case where we have done a plastic procedure for tubular occlusion we may do an associated suspension."

"In a teaching hospital with 7,500 gynecological admissions annually we do about three suspensions a year."

"We practically never do a suspension as a primary procedure. Sometimes we will do a suspension as a part of a conservative operation for pelvic endometriosis."

"In the last 2500 gynecological operations done in this institution we did one suspension as an incidental procedure. We find relatively no indication for it."

"There have been no primary uterine suspensions since this department was formed in 1945. We do not believe that uncomplicated retrodisplacement is a source of symptoms or disability."

"We have had one indication for uterine suspension. We see that each resident does one before he completes his service."

"We permit no uterine suspensions by anyone for any cause."

"If a patient has had children and is beyond wanting more, we prefer to do a hysterectomy. We find little use for the procedure."

"Probably once a year we do a uterine suspension. It is our feeling that the retrodisplaced uterus cause no symptoms."

"Twenty years ago we did 20 to 30 a year. Now we will not average one a year but we do feel that it has a limited place."

"There are practically no indications. In the past 18 months we have done one uterine suspension."

"The only indication left is in the conservative operation for pelvic endometriosis. Aside from this it is a relatively useless procedure."

"Our indications are extremely rigid. We must first rule out through orthopedic consultation any organic disease of the musculoskeletal system."

Also there must be relief from pain after a trial use of pessary for three to six months. Of 1200 gynecological operations annually we do about three."

"We consider suspension of the uterus as meddlesome and useless surgery except in the rare instance of conservative surgery for pelvic endometriosis."

"Thirty years ago it was a common procedure. Now we do about one a year for endometriosis. I do not believe any operation has been abused more than suspension of the uterus unless it is the removal of physiological cysts of the ovary."

"Regarding our policy of uterine suspension, we have a policy of not doing them. I have done one in the past three and one half years for a pelvic endometriosis."

"We find only a rare use for the procedure. Of 500 operations annually we do about three."

"I have done about 15 uterine suspensions in as many years of practice. I find only a rare indication."

"Probably within the past five years we have done five uterine suspensions, otherwise the operation has fallen into disuse at this hospital in recent years. We use it in rare cases of infertility and in association with presacral neurectomy for dysmenorrhea.

"The operation for uterine suspension has not been subjected to the procedure elsewhere and that reported in the literature by those observers who have bothered to follow up the cases of uterine suspensions and have found that it is a totally worthless procedure."

H. S. Heaney, in his discussion of a paper by Aldridge¹ on uterine suspension stated that in his opinion the symptoms for which suspension is usually done are not due to the position of the uterus but the accompanying pathology. He stated that in 1939 there were 17 suspensions done at the Presbyterian Hospital in Chicago. Bourgeois² states that uterine suspension, formerly one of the commonest of gynecological operations, is now rarely necessary and attention should be more properly directed toward associated pathology.

In most methods employed for suspending of the uterus there are certain inherent dangers of future difficulty. Many ingenious methods have been devised to avoid these. The most common has been the development of a small bowel obstruction. Pulrang⁴ in reporting a case of volvulus of a segment of small bowel following a Baldy-Webster suspension reviewed 15 previous reports of a similar pattern.

The author has personally handled 3 cases of small bowel obstruction, one of which required resection, following a Barrett type of suspension. We must admit that this is an inherent danger in many abdominal operations but the Baldy-Webster suspension has lent itself particularly well to this complication.

In light of what seems to be a very conservative attitude toward

the use of the operation for uterine suspension today, certainly by experienced and learned gynecologists, and without studying the type or indication for the procedure, the statistics are given in detail for one medium sized hospital in an urban midwestern community and in a rather cursory fashion from two other general hospitals. All are general hospitals with open staffs as has been indicated before.

Hospital A is a 303 bed institution in an urban community with about 9,500 annual admissions. In a four year period from January 1947 through December 1950 there were 291 uterine suspensions done (table 1). Two hundred and twenty-seven were done with an entrance diagnosis of uterine retroversion and 63 were found at surgery and corrected or done in association with other surgery. This is an average of 72.7 suspensions annually which would seem from the preceding survey to be excessive.

TABLE 1

1947	1948	1949	1950	Total	Annual Average
79	74	77	61	291	72.7

Hospital B is a 171 bed institution in the same community with an annual admission rate of about 6,000. In the same period there were 117 uterine suspensions done or an average of 29.2 annually. Table 2 shows that there has been a marked decline in the suspension rate of this institution in the past two years. This might be accounted for in two ways. Many of the older surgeons who formerly used this procedure frequently have retired, and secondly as hospitals A and B have essentially the same staff several of the surgeons who formerly worked in hospital B now do most of their work in hospital A.

TABLE 2

1947	1948	1949	1950	Total	Annual Average
36	47	18	16	117	29.2

Hospital C is located in a larger community than hospitals A and B and is a 650 bed institution with about 16,000 annual admissions. Total figures for the period of July 1949 through June 1950 were all that could be obtained. In that period 75 uterine suspensions were done making an annual total for the two year period 37.5. It might be inserted here that hospital C has in recent times undergone a considerable change in its staff set-up to conform to standards required for approved residency services.

As hospitals A and B are in the same community the combined figures for the total bed capacity of 474 was 408 uterine suspensions in the four year period. Table 3 shows that when the two are combined as might be surmised there is definite trend toward fewer suspensions.

TABLE 3

1947	1948	1949	1950	Totals	Annual Average
115	121	95	76	408	102

We may note that this average is considerably greater per year than hospital C with a greater bed capacity and annual admission rate. The suspension procedures in hospitals A and B were done by 33 different and individual physicians. Eight surgeons of the 33 did 58.6 per cent of the uterine suspensions, 32 were performed by specialists in obstetrics and gynecology, of which 22 were done by one specialist, 10 were done by four general surgeons and the remaining 360 for the four year period were done by general physicians; 131 or 32.1 per cent of the total suspensions for the four year period were done by three general surgeons. As might be seen from these statistics any one of several surgeons may do more uterine suspensions annually than any university hospital group or large private clinic.

In hospital B where a more complete study of the problem was possible, the percentage of suspensions to total number of intra-abdominal gynecological procedures was computed as shown in Table 4. Again we may see a sharp decline in the frequency of suspension.

TABLE 4

	1947	1948	1949	1950
Gynecologic operations	195	275	117	190
Suspensions	36	47	18	16
Total per cent	18.4%	17.0%	15.3%	8.4%

DISCUSSION

There seems little doubt that the operation of uterine suspension is abused. As has been stated 20 per cent of all women have a retroverted uterus. Because in the past much importance has been attached to the condition as a cause of degeneration of the ovaries, backache, constipation, dyspareunia, sterility, frequency of urination, bearing down feeling and nervousness and as the numerous procedures devised for its correction offer little technical difficulties

and the diagnosis may be made with ease and dispatch, it has lent itself readily to abuse.

There should be a more conservative attitude toward the condition by those of us who practice general medicine and we should not be pushed into useless and sometimes troublesome procedures that bring at best a minimum of good results. There are certainly indications for the suspension of the uterus but they should be carefully evaluated in each situation. After all suspension is not an emergency procedure and much study and observation can and should be made before the procedure is recommended. The value and usefulness of many of the numerous pessaries available should be a part of our armamentarium.

CONCLUSION

1. Uterine suspension is a procedure that has merit in certain well chosen and studied cases.
2. The operation is abused, as indicated by its frequency in three general hospitals.
3. A plea is made for serious consideration of the individual case where uterine suspension is contemplated and a more strict adherence to the indications that are outlined in this communication.

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THE REPAIR OF MASSIVE CALVARIAL DEFECTS

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THE loss of a segment of the calvarium due to an avulsive injury, a gunshot wound, or a surgical procedure for malignancy may leave a large defect in the scalp and skull which cannot be closed by any ordinary surgical technics. As a result of the defect the unprotected brain tissue tends to herniate and develop into an infected fungating mass as illustrated (fig. 1).

In many patients with such calvarial defects the brain can be prevented from herniating by the repeated withdrawal of cerebrospinal fluid, a marked restriction of the fluid intake, and other dehydrating procedures. If the brain can be retained for a sufficient period, granulation tissue will eventually cover the exposed area. The defect can then be skin grafted to provide a protective epidermal covering for the brain.

During the interval preceding the skin grafting, however, the patient is subjected to many dangerous situations. First, his brain is exposed in a dressing that cannot be kept dry because of leakage of cerebrospinal fluid from the meninges and perhaps a ventricle. Meningitis, therefore, is always imminent. Second, the repeated withdrawals of central nervous system fluid cause a great deal of trauma, discomfort, and gradually increasing danger of thecal space contamination. Third, all of the procedures directed towards securing dehydration are opposed to the physiologic needs of a patient who has suffered from such a mutilating injury or surgical procedure. Furthermore, a successful covering of the brain with skin leaves the patient crippled with a dangerous pulsating cranial defect.

The first case illustrates a method of treating fungus cerebri with tantalum wire mesh.

CASE REPORTS

CASE 1. A white male, aged 47 years, was admitted to the University Hospital on Jan. 6, 1949. He had had an inadequate surgical removal of a basal cell carcinoma from the right frontal and temporal region in 1941, again in 1944, and again in 1946. The operation in 1946 included removal of a large segment of the underlying frontal and temporal bones, but none of the dura was removed. The resulting defect in the calvarium had been covered with skin grafts and had revealed no evidence of recurrence until August, 1948.

On admission, there was proved evidence of basal cell carcinoma in several

ulcerating areas beyond the periphery of the previous operative site and in the bone around the cranial defect. The carcinoma had also invaded the upper portion of the right ear and there was a nodule of carcinoma in the soft tissues inferior to the right mastoid process.



Fig. 1. Patient with fungus cerebri which developed following extensive resection of scalp, bone, dura, and brain tissue for recurrent basal cell carcinoma.

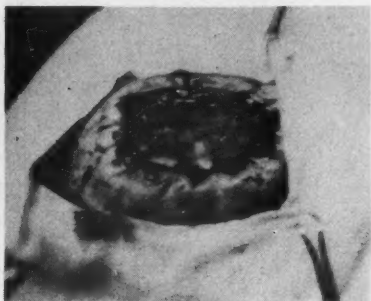


Fig. 2. View of case 1 showing the fungus cerebri reduced and covered by tantalum gauze mesh.

On Jan. 25, 1949, an extensive resection of the carcinoma was carried out with removal of a segment of scalp, bone, dura, some brain, and most of the right ear.

Following the above surgery, all efforts to keep the brain decompressed were unsuccessful, and a fungus cerebri gradually developed. By Feb. 10, 1949, the herniating brain appeared as in figure 1. Small areas of pressure necrosis were beginning to develop. Later the spinal fluid became cloudy and contained cells too numerous to count. The temperature curve began to show a septic course, and the mental status degenerated into a stuporous condition. It appeared that the patient would surely die.

On March 24, 1949, however, the patient was still alive. Although he was desperately ill, his condition seemed no worse than it had been a month before. On this date, therefore, the patient was prepared by removal of all possible central nervous system fluid by spinal tap, thereby giving maximal decompression of the brain. The necrotic areas of brain were trimmed away and some of the redundant brain tissue was excised. Then two "half-disk" shaped pieces of tantalum wire mesh were inserted under the margins of the bony defect and were fixed to the peripheral dura and adjoining fibrous connective tissue with interrupted No. 0000 tantalum wire sutures. The central portions of the mesh were overlapped and then slowly tightened over the fungus cerebri by means of interrupted sutures. As the sutures were tied, one piece of mesh slid under the other allowing the whole mesh covering to reduce and adequately contain the herniating brain (figs. 2, 3). The patient lived for five days following the operative procedure.

Comment. This patient was in extremis when active treatment with tantalum mesh was undertaken. If the tantalum mesh had been inserted on Jan. 25, 1949, when the brain was first exposed, the fungus cerebri would not have developed. If the tantalum mesh had been applied over the herniating brain even two or three weeks after it began to extrude, the patient would have had a better chance for survival.

The second case illustrates a method of preventing fungus cerebri by the usage of tantalum wire mesh.



Fig. 3. Preoperative and postoperative skull films in case 1 showing: (a) area of previously resected skull, (b) medialward extension of carcinoma, (c) additional area of skull resected on reported admission, (d) tantalum gauze partially covering the bony defect and retaining the brain tissue.

CASE 2. A white male, aged 22 years, was admitted to the University Hospital on Aug. 5, 1949. He had had an inadequate removal of a squamous cell carcinoma (Marjolin's ulcer) from the left parieto-occipital region in August 1945 and again in July 1946. The latter operation had consisted of removal of the carcinomatous area together with a portion of the underlying bone, dura, and brain. The dissection had been carried medialward to expose, but not to include, the sagittal sinus and falx cerebri. Skin grafting of the resultant calvarial defect had been successfully accomplished.

On admission, there was evidence, proved by biopsy specimens, of recurrent carcinoma and bone destruction beyond the posterior aspect of the previously made surgical defect near the mid-line (fig. 4). The patient's general condition was excellent.

On Aug. 11, 1949, a block resection of the carcinomatous area was performed and included a generous area of scalp, bone, dura, and brain. The falx cerebri and middle portion of the sagittal sinus were found to be involved, so a segment of each was resected. Resection of the sagittal sinus was accomplished, although with considerable expense of blood and time. It was our fear that the patient would not tolerate removal of the segment of sagittal sinus without the intervention of some paralysis unless the sinus had been previously obstructed by the carcinomatous growth. Fortunately, the patient did tolerate the above operative procedures without suffering any paralysis or great amount of shock.

The resulting calvarial defect was then covered with a circular disk of tantalum mesh, the edges of which were tucked under the borders of the sur-

gical defect and fixed in place with interrupted No. 0000 tantalum wire sutures (fig. 5).

On the day following the above surgical procedures, the patient was alert, able to eat, and presented no neurologic disorders. Since there was leakage of central nervous system fluid through the tantalum mesh, it was decided not to perform spinal taps unless evidence of increased intracranial pressure developed. The dressings of iodoform gauze or furacin gauze were observed to be dampened with central nervous system fluid for 20 days (fig. 6) but skin grafting of the defect was delayed until all of the mesh was well covered with granulation tissue and epithelium was growing in from the margins of the defect.



Fig. 4. View of scalp in case 2 showing area of recurrent squamous cell carcinoma. The alopecic area represents the scar of a burn suffered 18 years before as well as the scar of two previous operative resections of carcinomatous material.



Fig. 5. View of operative site in case 2 immediately after the carcinomatous growth together with an area of scalp, bone, dura, brain, falx cerebri, and superior longitudinal sinus had been resected and the calvarial defect was covered with tantalum gauze mesh.

On October 18, 68 days after the block resection, the granulating area was covered with pinch grafts and a 100 per cent "take" was obtained (fig. 7). The patient was discharged on October 25, 78 days following the massive resection of calvarial and brain tissue. A recent check-up examination reveals the grafted area and implant to be intact. There has been no evidence of recurrent carcinoma.

Comment. The immediate application of tantalum mesh to the calvarial defect in this case obviated the possibility of a fungus cerebri developing. Repeated withdrawals of central nervous system fluid to keep the brain decompressed were unnecessary. Repeated dressings of the wound were simplified. The patient was allowed a great deal of freedom, and was comfortable throughout the postoperative course. An adequate diet and fluid intake were

maintained at all times. The resultant cranial defect has been much more stable than it would have been without the wire mesh implant. Last, but not least, it would appear that the patient has been subjected to a radical but curative excision of his cranial carcinoma without suffering irreparable damage.

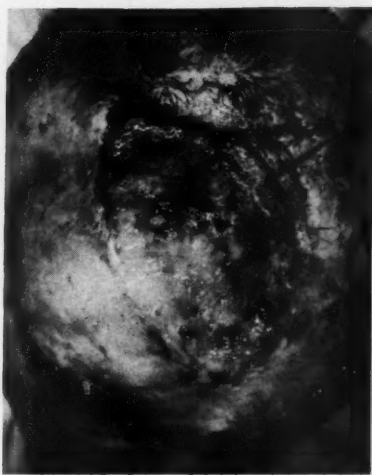


Fig. 6. View of operative site in case 2, 10 days after the tantalum mesh had been implanted. Note the growth of granulation tissue through the mesh which is not yet completely covered with granulations.



Fig. 7. View of case 2 showing the calvarial defect and tantalum mesh covered with skin 78 days after the tantalum mesh had been implanted.

DISCUSSION

The surgical literature contains numerous reports on the successful usage of inert metal plates (tantalum, stainless steel, vitallium), for repair of defects in the skull. There is one report on the usage of stainless steel wire mesh.¹ It is believed, however, that all previous reports include cases in which it was possible to cover the metal grafts immediately by reapproximating the scalp structures or by plastic surgery. In neither of the cases herein reported would it have been feasible, at any time, to have covered the calvarial defects with scalp structures or with pedicle grafts. Both patients had been subjected to previous operative procedures or injuries which had spoiled the surrounding tissues for plastic surgery.

It is suggested that the application of the methods herein described will be of value in preventing or treating fungus cerebri in other patients who, for one reason or another, lose a large segment of their calvarial tissue. Further exploitation of the possibilities in

the usage of inert wire mesh for repair of calvarial defects may well encourage the surgeon to extend his indications to include defects and diseases previously considered incurable.

It is also suggested that the utilization of a more rigid wire mesh would give greater stability to the implant. It is also believed that the employment of a mesh with larger openings would allow a more rapid overgrowth of the granulation tissue which is essential for the grafting of skin over the implant.

We have recently learned³ of the availability of stainless steel wire mesh which can be obtained from the W. S. Tyler Company of Cleveland, Ohio. This firm, and perhaps others, supplies mesh of nearly any weight or size of opening.

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PARTIAL NEPHRECTOMY

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PARTIAL nephrectomy is the removal of a portion, usually one pole, of a normally developed kidney. It is not to be confused with heminephrectomy, which indicates the removal of one-half of a congenitally double kidney with each half having a separate and distinct blood supply.

This procedure is well known and its value recognized. However, it is not universally practiced. A review of the literature by Abeshouse and Lerman in 1950 revealed only 193 reported cases. The reluctance to perform this valuable procedure is due in part to unjustified emphasis having been placed on the occasional complications of secondary hemorrhage and urinary fistula. It is the purpose of this paper to reemphasize the value of partial nephrectomy and to present refinements in surgical technic which it is believed will markedly reduce or eliminate these complications.

The technic described below is based on the experience gained from 15 cases. One case each presented through the courtesy of Dr. James Campbell of Valdosta, and Drs. Beard and Goodyear of Atlanta. These cases were performed over a five-year period. The last one was in January, 1952. The average age was 41 years. The youngest patient was 18 years of age and the oldest one was 67. There were 5 men and 10 women patients. The right kidney was involved 5 times and the left kidney 10 times. One patient had both kidneys affected.

Pathology was present in the superior pole in 11 kidneys and in the inferior pole in 4 instances. The pathologic diagnoses were as follows: Localized calculus disease with hydronephrosis in 9 kidneys, localized calculus disease with multiple localized abscesses in 1 kidney, localized calculus disease without hydronephrosis in 3 kidneys, localized calculus disease with a separate calyceal diverticulum both located in the same pole in 1 kidney and 1 instance of traumatic involvement of a kidney.

The knowledge gained from these 15 cases produced an evolution in technic. With increasing experience in the performance of par-

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Presented during the Atlanta Assembly of The Southeastern Surgical Congress, March 10-13, 1952.

tial nephrectomy it was found possible to overcome the difficulty of hemorrhage during the operation by using only simple point ligation of obvious bleeding vessels instead of using the large mattress-type ligatures formerly employed. It was found that bits of avascular tissue such as fat or muscle were not necessary as aids to hemostasis. Oxycel was discarded. The renal capsule was closed loosely over the severed area instead of the tight closure formerly employed. It was found that postoperative edema of the kidney would adjust the tension of a loose closure of the capsule and would pull out the sutures of a tight closure.

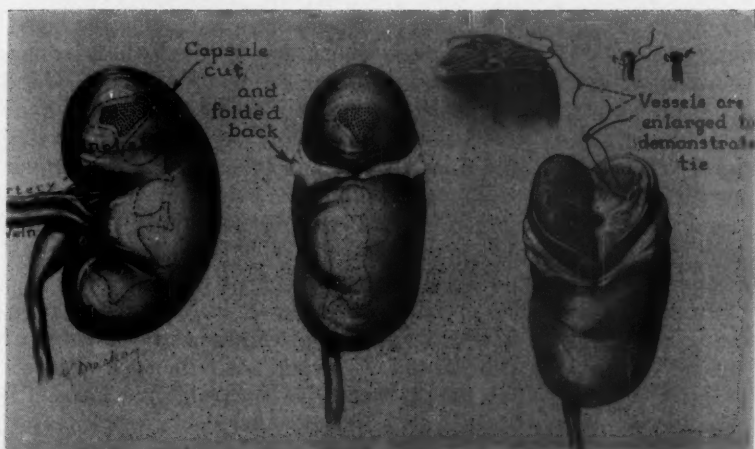


Fig. 1. The renal capsule is incised coronally and carefully stripped downward to healthy tissue. The area of pathology is removed in a wedge shape by sharp dissection. The obvious bleeding vessels are secured by a suture ligature placed deeply and widely through the renal parenchyma. This ligature when tied will cut through the soft renal tissue and will contain only the vessel. The opening into the renal collecting system is closed with a fine continuous catgut suture. The renal capsule is also closed with a continuous catgut suture. This closure reapproximates the severed edges of the kidney.

The evolved technic is as follows: Adequate exposure of the kidney is very necessary for it must be mobilized completely. A subperiosteal resection of the twelfth rib easily provides this exposure. This resection is most often necessary if the pathology is located in the left superior pole. Renal pedicle clamps are not necessary. Hemostasis of the renal operative field is achieved by digital pressure on the severed edges as described by Hess. Occasionally, a careful search of the renal pedicle will reveal a single artery to the involved area. Initial ligation of this vessel will produce an almost bloodless operative field. Mathe first suggested this procedure. The capsule should be carefully preserved. It is incised coronally

and then it is gently stripped back to healthy renal tissue. The area and extent of the pathological process is determined by incising the renal paranchyma coronally and opening it like the pages of a book. When the extent of the pathology has been observed it is removed in the shape of a wedge by sharp dissection. This wedge shape facilitates the approximation of the severed edges when the capsule is closed. An electrocautery should not be used as this favors later sloughing of tissue and resulting secondary hemorrhage. The opening into the renal collecting system is closed with a fine continuous catgut suture. The point ligation of obvious bleeding vessels with a small suture ligature is most important. The suture is placed widely and deeply into the renal parenchyma surrounding the bleeding vessel. When the ligature is tied it cuts through the soft surrounding tissue until the noose contains only the vessel. Good hemostasis is thus easily obtained. Large mass ligatures such as the cobbler's stitch or a large mattress suture waste valuable renal tissue and produce conditions favorable to the growth of bacteria and to the later sloughing of tissue. The renal capsule is closed loosely with plain catgut continuous suture. A nephropexy is then done to replace the kidney and ureter in their normal physiological positions. Always obtain a biopsy specimen of the remaining portion of the kidney. This small procedure gives information of prognostic value. Have bacteriological cultures made of the involved areas. This is a most accurate aid in antibiotic therapy. Penrose drains are placed down to the operative area and the incision is closed in a routine fashion. The drains are left in 12 to 14 days.



Fig. 2

CASE 1. C. W. L., a 40 year old white man, was admitted to the urological service April 11, 1947, with a typical attack of left renal colic. Physical examination was negative except for marked tenderness in the left flank. Lab-

oratory studies were noncontributory except for the finding of 10-12 white blood cells per high power field in the urine. Retrograde pyelograms revealed a large calculus in the superior calyx of the left kidney. Partial resection of the left superior pole was performed on April 18, 1947, under endotracheal anesthesia. The twelfth rib was resected subsuperiosteally. A cobbler's stitch was used to produce hemostasis of the renal operative field. Oxygel was also used beneath the capsule for hemostasis. Approximately 25 Gm. of tissue were removed with the calculus.

Pathology report: Chronic pyelonephritis. His urine is microscopically negative today and he has had no recurrence of his original pathology (fig. 2).

Early in this series two complications occurred which greatly influenced the evolution of our technic. The first complication was that of a urinary fistula which closed spontaneously after five months. This occurred in a kidney where a cobbler's stitch had been employed. Oxygel gauze had also been placed beneath the capsule. The second complication occurred in a case where a cobbler's stitch had been placed very tightly through the renal parenchyma. Severe secondary hemorrhage occurred on the ninth postoperative day. This finally resulted in a nephrectomy on the twelfth postoperative day.

CASE 2. G. M. H., a 59 year old colored woman, was admitted to the urological service July 14, 1950, with a one-day history of severe right flank pain accompanied by chills and fever. Past history revealed she had had intermittent attacks of dull pain in the right flank for the past two years. The physical examination revealed an obviously ill woman with extreme right flank tenderness. Urinalysis showed innumerable white blood cells per high power field. Nonprotein nitrogen was 26 mg. per cent. All other laboratory studies were normal. Retrograde pyelograms demonstrated two small stones in the right superior pole with blockage of the right superior calyx. Partial nephrectomy of the right superior pole was done on July 28, through a right flank



Fig. 3

incision with subperiosteal resection of the twelfth rib. The upper fourth of the right kidney was studded with many small cortical abscesses. There was a definite line of demarcation of this area. Resection of the upper fourth of the kidney was effected by using a row of interrupted mattress sutures placed

quite loosely through the parenchyma. Point ligation of individual bleeders was carefully performed. The capsule was closed loosely. A renal pedicle clamp was used.

Pathology report: Acute and chronic pyelonephritis with abscess formation and localized calculus disease. Thirty-five Gm. of renal tissue were resected. Follow-up studies have revealed a sterile urine with no recurrence of her original pathology (fig. 3).

CASE 3. G. M. H., an 18 year old colored woman, was admitted to the urological service on March 3, 1951, complaining of gross, painless hematuria of one day's duration. Past history revealed that seven days prior to admission she had fallen down a flight of steps and had injured her right side. She denied having had any hematuria at that time. Physical examination revealed tenderness in the right flank. Involuntary spasm of the right flank muscles was marked. No mass could be felt. Urine was grossly bloody. Retrograde pyelography demonstrated a complete rupture of the right kidney in its inferior pole.

Partial resection of the right inferior pole was done on March 7. The entire inferior pole was shattered into several pieces. No renal pedicle clamp was used. Fragmented tissue was cut away until normal parenchyma was reached. Hemorrhage was controlled by point ligation of the individual vessels with small suture ligatures. No omentum, muscle or fat were placed beneath the capsule. The capsule was closed loosely over the remaining portion of the inferior pole. No mass ligatures were used. Twenty-four Gm. of tissue were removed.

Pathology report: Necrotic renal tissue. A separate specimen for biopsy of the superior pole, taken at the time the inferior pole was resected, was reported as chronic pyelonephritis. The pathologic picture indicated that this condition had existed prior to the traumatic incident. Follow-up studies of the



Fig. 4

patient revealed microscopically negative urine in one month's time with the remaining portion of the kidney functioning normally (fig. 4).

In 3 of the 15 cases which were done recently the remaining renal

tissue was biopsied in an effort to obtain information of prognostic value. The importance of this simple procedure cannot be stressed too much. The renal tissue in 1 case was normal and in the remaining 2 cases showed a moderate degree of chronic pyelonephritis. This information, together with a bacteriologic culture of the pathologically involved area of the kidney, permits accurate antibiotic therapy and an intelligent evaluation of the status of the remaining portion of the kidney.

Partial nephrectomy is to be greatly preferred over the radical procedure of nephrectomy in instances of localized renal pathology. The sacrificing of a large amount of healthy renal tissue just to remove a small amount of diseased tissue is to be condemned. Also the removal of a stone in localized calculus disease without attempting complete removal of the surrounding involved tissue is likewise condemned. The patients in this series, small though it is, are completely free of symptoms. They have had no recurrence of any stones and their urine is sterile. Also they still possess a large amount of adequately functioning renal tissue which might otherwise have been sacrificed. These facts point out the tremendous value and advantage of partial nephrectomy. This surgical procedure is not difficult and the fear of secondary hemorrhage and urinary fistula is not justified if the use of necrotizing mattress-type ligatures is avoided and the principle of point hemostasis is followed.

SUMMARY

1. Fifteen cases of partial nephrectomy including 1 case of bilateral partial nephrectomy for localized renal disease are presented.
2. Refinements in the surgical technic of partial nephrectomy are emphasized.
3. The importance of a renal biopsy is stressed.

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UTILIZATION OF THE APONEUROSIS TRANSVERSUS ABDOMINIS, COOPER'S LIGAMENT AND THE ILIO-PUBIC TRACT IN THE REPAIR OF INGUINAL AND FEMORAL HERNIAS

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THE anatomic weakness resulting in the development of direct and femoral hernias is in the innermost layer of the abdominal wall, the transversalis fascia. Indirect inguinal hernias result from the existence of a congenital sac, frequently associated, however, with transversalis defects, since in our experience "recurrent" indirect hernias are in reality direct hernias in the majority of instances. It is logical to correct existing transversalis weakness at the time of the repair of any hernia in the inguinal region.

ANATOMY

Textbooks of anatomy inadequately describe the transversalis fascia as a "thin membrane which lies external to the peritoneum of the abdominal wall," and name such a variety of fossae, layers, and fusions of structures that both students of anatomy and surgeons become lost in a maze of historical names and anatomic terms when trying to develop a practical knowledge of the anatomy of the inguinal region. Some simplified standard anatomic description of the surgically important structures in this region should be adopted. Careful anatomic dissections of the transversalis fascia in the inguinal region show it to be an elastic structure consisting of two strong fibrous bands united by a thinner tissue. The fibrous bands are, medially the aponeurosis transversus abdominis muscle and laterally, the iliopubic tract (fig. 1). Some of the fibers of the aponeurosis transversus abdominis blend with the lateral margin of the rectus sheath. Inferiorly some of them fuse with the periosteum of the pubic tubercle. The majority of them, however, insert into Cooper's ligament along the pecten or crest of the pubis. This aponeurosis transversus abdominis forms the innermost or deeper layer of the so-called "conjoined tendon."

The iliopubic tract, the lateral fibrous band of transversalis fascia passes from the anterior inferior iliac spine, where it blends with the iliopsoas fascia, to the pecten of the pubis where it blends with

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Cooper's ligament and with the periosteum of the pubic tubercle. Inferiorly the tract is loosely attached to the shelving margin of the inguinal ligament, passes under the ligament and into the thigh as a

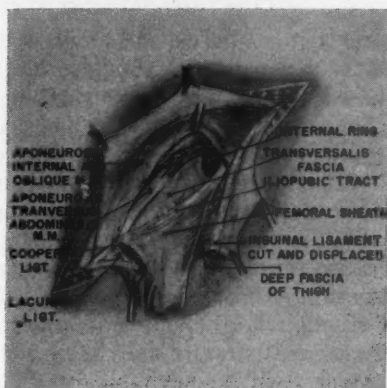


Fig. 1. The anatomy of the femoral sheath and transversalis fascia.

part of the femoral sheath, demarcating the abdominal component of the transversalis fascia from that of the thigh. It is easily separated from the inguinal ligament and must be separated from the ligament before it can be adequately exposed and visualized as a



Fig. 2. Transposition of direct sac into an indirect inguinal hernia.

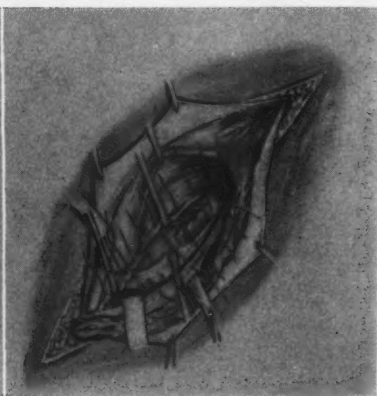


Fig. 3. Repair of the transversalis fascia.

tract. These two fibrous thickenings of the transversalis fascia, the aponeurosis transversus abdominis and the iliopubic tract, and Cooper's ligament, are of primary anatomic importance in the

repair of indirect inguinal, direct inguinal, and femoral hernias (figs. 4, 5).

HERNIOPLASTY

Regardless of the type of hernia to be repaired, an oblique incision is made over the inguinal canal, clamping the superficial vessels before they are severed. The aponeurosis of the external oblique is opened from above downward, exposing and preserving both the iliohypogastric and the ilio-inguinal nerves. The cord is picked up and the areolar tissue overlying the pubic tubercle and the cremaster muscle are wiped medially with a moist gauze sponge, exposing the shelving margin of the inguinal ligament and the underlying ilio-pubic tract. All excess fat is carefully removed from the cord structures. The peritoneum is isolated and incised at the internal ring and intraperitoneal digital exploration is done. This step is extremely important as multiple sacs may be present and if they are not removed, recurrence will be inevitable, regardless of the type of repair. We convert all sacs, both direct and femoral, to indirect sacs after the method of Houget² (fig. 3). This assures removal of all sacs and potential sacs and if properly and carefully done prevents bladder injury when dealing with large direct sacs. The sac is closed high with a purse string suture of quilting cotton and allowed to retract beneath the internal oblique muscle. It is not

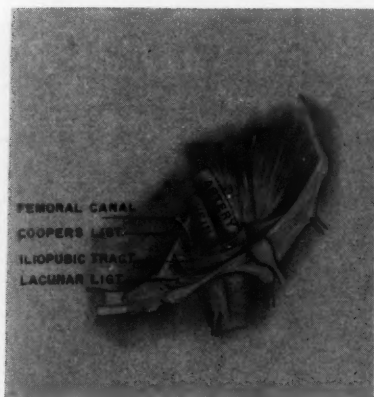


Fig. 4. Diagram of the femoral sheath and femoral canal.

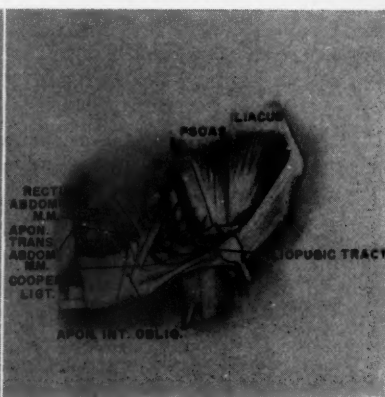


Fig. 5. Closure of the femoral canal.

transfixed. The defect in the transversalis fascia at the internal ring that becomes apparent after the neck of the sac retracts, is closed tightly around the cord structures with interrupted quilting cotton sutures, care being taken to invert the preperitoneal fat. This

closure of the transversalis fascia at the internal ring is extremely important as pointed out by Lytle.³ The omission of this internal ring closure may be as frequent a cause of recurrence of indirect hernia as is failure to remove the entire sac.

The internal oblique muscle is next isolated, clamped with an Allis forcep, and retracted medially, avoiding later inadvertent suture of the muscle and its aponeurosis to the deeper structures. Cooper's ligament is then palpated as a tough ridgelike band extending from the pubic tubercle laterally at an angle of 30 degrees along the pecten of the pubis (ilio pectineal line). The transversalis fascia is separated from the structures overlying the pubic tubercle with a small straight forceps exposing the anterior 2 cm. of Cooper's ligament (fig. 3). This separation must be done close to the pubic tubercle without opening the transversalis fascia or preperitoneal fat will bulge into the wound making the repair difficult and recurrence likely, since including adipose tissue in sutures results in poor healing. The lateral margin of the aponeurosis transversus abdominis is then sutured successively from below upward to the periosteum of the pubic tubercle, Cooper's ligament, and the ilio-pubic tract. The first suture is taken through the aponeurosis transversus abdominis 1 cm. cephalad to the pubic tubercle. This "swinging down" of the aponeurosis can be done without producing tension on the suture line. If this is not done, this first suture may cut through, resulting in a recurrence just above the pubic tubercle. ? Using a heavy No. 4½ curved Mayo taper pointed surgeon's needle* the aponeurosis transversus abdominis is sutured to Cooper's ligament with from two to four interrupted sutures depending upon the length of Cooper's ligament. When the iliopubic tract is reached, the sutures pass through the lower margin of the aponeurosis transversus abdominis and the iliopubic tract up to the internal ring. These sutures are then tied from above downward. This completely closes the femoral canal (fig. 4), plicates the transversalis fascia and substitutes the strong fibrous portions of the transversalis fascia for the thinned-out portion of the fascia through which direct hernias protrude (fig. 1). The closure of the femoral canal is illustrated in figure 5. The aponeurosis and muscle of the internal oblique abdominal muscle is then sutured to the shelving margin of the inguinal ligament from below upward as in the usual Bassini repair. The muscle fibres are sutured tightly around the cord at the internal ring. Our dissections of recurrent hernias have shown that the epimysium of the muscle will firmly unite to the inguinal ligament, provided no fat is included in the suture, and we do not hesitate to include muscle fibers, provided the closure is done without

*Manufactured by the Torrington Company, Torrington, Conn.

tension. If the aponeurosis of the internal oblique muscle inserts high into the rectus sheath, a vertical relaxing incision in the rectus sheath after the method of Rienhoff⁴ is made to prevent tension on the suture line. Relaxing incisions are routinely made when bilateral hernias are repaired. The aponeurosis of the external oblique is then sutured loosely over the cord, leaving a loose external ring. We do not believe that if the inner two reconstructed walls fail to hold that the external oblique fascia can by itself prevent recurrence, so nothing is done except to approximate its cut edges. This prevents edema of the scrotal contents during the postoperative period. We use quilting cotton sutures placed at $\frac{1}{2}$ cm. intervals for the majority of our repairs. For large direct hernias, recurrent hernias, or scrotal hernias in elderly or obese persons, a continuous suture of fascia lata $\frac{3}{4}$ to 1 cm. wide and 20 to 25 cm. long obtained with a Masson stripper is used for uniting the first or deeper layers. When fascia is used, it must be anchored at frequent intervals with interrupted quilting cotton sutures. The technic of the fascial repair has been given in more detail in a previous paper.¹

RESULTS

We have recently reviewed the results of 774 inguinal and 19 femoral hernias repaired with this technic since 1943. Approximately one half of this number were done by one of us (J.H.C.) and by junior surgeons in an army hospital during World War II, and only an incomplete two-year follow-up was possible on these cases. One hundred and thirty-two of the repairs were done by Dr. K. B. Castleton at the Holy Cross Hospital in Salt Lake City, 129 were done by resident surgeons at the Salt Lake Veterans Administration Hospital. The remainder were done by the authors at the St. Mark's and Holy Cross Hospitals in Salt Lake City. To date we have been able to find 13 recurrences, five indirect and eight direct. We realize that the follow-up has not been complete and that more recurrences can be expected during the next 10 to 15 years. It has been shown by Watson,⁵ however, that over 50 per cent of recurrences develop during the first six months and we believe that this operation, based upon sound anatomic principles, will stand the test of time.

The indirect hernias were unilateral in 286 patients and bilateral in 76 patients. In 55 patients direct and indirect or "pantaloon" sacs were found. This emphasizes the importance of the intraperitoneal exploration of the sac and of the Hogue maneuver previously mentioned.² There were 136 unilateral direct and 64 bilateral direct hernias repaired. The majority of the recurrent hernias repaired were found to be direct hernias. There were 61 unilateral

and 15 bilateral direct sacs in this group. There were 23 unilateral indirect and 4 bilateral indirect recurrent hernias repaired. Strips of fascia lata were used as suture material in 54 patients, seven being large scrotal indirect hernias in elderly or obese individuals, 37 large direct hernias in patients with poor tissues, and 10 difficult recurrent hernias. The only complication in this group was one herniation of the thigh muscles through the defect in the fascia that required closure of the fascia. These cases have all been followed closely and to date there has not been a recurrence in the group, indicating the superiority of fascia lata strips as suture material.

Of the 19 femoral hernias repaired, 5 were for recurrences that had previously been repaired from below. There was not a recurrence of a femoral hernia and while the cases are few, the illustrations (figs. 4, 5) show the complete closure of the femoral canal accomplished by the described technic.

SUMMARY

A simplified technic for the repair of inguinal and femoral hernias utilizing the strong fibrous portions of the transversalis fascia, the aponeurosis transversus abdominis muscle, the iliopubic tract, and Cooper's ligament is described. The results obtained in the repair of 774 inguinal and 19 femoral hernias is presented. The superiority of fascia lata strips as suture material for the repair of difficult hernias is discussed.

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THE SURGERY OF GALLBLADDER DISEASE

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Two hundred and ninety patients were treated surgically during the first eight years after the founding of the Bowman Gray School of Medicine; from Jan. 1, 1942, to Jan. 1, 1950. The number of cases is admittedly small; however, many of the surgeons concerned had been doing gallbladder surgery for years before the founding of the Medical School. This brief paper is a statement of our general philosophy about gallbladder surgery and a résumé of the 290 cases.

The two surgical performances which have perhaps contributed most to skepticism on the part of the medical man, especially, are first the removal of normal or nearly normal gallbladders, and second injury to the common duct during surgery. It is difficult to get many facts about the first, but the second makes itself all too disastrously evident. That common duct injury is frequent is attested by several reports from the larger clinics on common duct reconstruction in numerous cases. It was in 1936-1937 when the American Board of Surgery was being formed that Dr. Lahey stated, "We are doing more today, by establishing high standards for the training of surgeons, to prevent common duct injuries than has ever been done before." However, as reported from at least one of the larger clinics, there was a definite increase in common duct injuries immediately after World War II, suggesting at least inadequate surgical training on the part of men who were rushed through both the medical school and hospital because of the exigencies of war. There can be no substitute for adequate and prolonged surgical training and for exact anatomical knowledge. Good exposure, proper lighting, efficient suction, and no clamping until the cystic and common duct junction is visualized, are the mechanical means for preventing duct injury. Gallbladders should not be removed unless their walls are definitely thickened or unless they contain stones or both. On the other hand, there is no such thing as an innocent gallstone. It is true that the roentgenologist cannot demonstrate all stones even when present, and a failure to demonstrate them should not prevent operation if adequate clinical evidence is present. We should all be willing to leave in situ a gallbladder that

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is thin-walled, purplish-blue in color, contains no stones, and in which the bile contains no sediment on aspiration.

The problems that have caused most discussion among surgeons of recent years have been first, common duct exploration, second, the management of acute cholecystitis, third, the cystic duct stump syndrome. It seems wise to explore the common duct in the presence of the history of jaundice or on finding hydrops of the gallbladder or on finding stones in the gallbladder, or if the common duct is definitely dilated and thickened. In our experience, 22 per cent of the patients have had their common ducts explored and in 31 per cent of those stones were found. Other indications for common duct exploration are not so definite.

It is our practice to remove gallbladders during the stage of acute inflammation. A few hours may be well spent in replacing fluid losses and assuring some relief from pain so that the patient will get rested before his surgical ordeal. Much time and discomfort can be prevented by the early removal of such gallbladders and the operation is often much easier to do than in the later, chronic adhesive phase of the disease. Also the threat of possible gangrene and rupture can be removed. However, as Dr. Collier has recently stated, "It may not be wise in all instances of acute inflammation to try to demonstrate the junction between the common and cystic ducts in the presence of acute inflammation, but rather be satisfied with a subtotal removal of the gallbladder if it appears to be dangerous to do otherwise." He apparently is not disturbed about leaving all of the cystic duct and a very small portion of the gallbladder in the patient.

As you know, the cystic duct syndrome has of recent years received considerable attention. From reports, it may become inflamed; it may form a cystic dilatation or an actual new growth, such as an adenoma, may develop. However, with the thousands of gallbladders that are being removed annually in the United States, many more cystic duct stump syndromes would undoubtedly be reported if they are at all common. And if complete or nearly complete cystic duct removal is insisted upon as being the proper thing to do, undoubtedly many more common duct injuries are going to occur.

Of these 290 patients with gallbladder disease, 230 were women and 60 were men. The youngest patient was 17 years old and the oldest was 82 years old. Greatest incidence was in the fifth decade. The presenting symptom in 201 patients was pain, which was re-

ferred to the right upper quadrant in 121 cases and to the epigastrium in the remaining. The pain was colicky in nature in a little less than half of the cases, and was dull and more or less constant in the others. The so-called typical radiation of pain to the right shoulder or back was present in only approximately a third of the patients. Nausea alone or nausea and vomiting occurred in slightly more than one-third of the patients. Jaundice was present on admission in 47 patients.

Oral cholecystograms were done on all patients except those that were jaundiced or who had obviously acute gallbladder disease. Of the cases proved at operation to have stones, cholecystograms were accurate in 65 per cent. In the remaining cases who had stones, not seen at cholecystography, 26 per cent showed a poor or nonfunctioning gallbladder, and 9 per cent showed a normal concentration of the dye. Of the cases in which *no* stones were demonstrated at operation, cholecystogram was reported as showing poor or nonfunctioning gallbladder in 44 per cent, as negative or normal gallbladder concentration in 41 per cent, and as showing stones in 14 per cent. Two hundred and fifty-five of the 290, or 88 per cent of all patients, were found to have stones in the gallbladder at surgery.

In attempting to make as complete a diagnosis as possible in patients with upper abdominal symptoms, it is often wise to examine the stomach and duodenum by a barium study even though definite pathologic changes have been demonstrated by the cholecystogram. This study was made in 151 instances and of those, 28 per cent were found to have definite pathologic change other than that in the gallbladder. The most frequent findings were duodenal diverticulum and duodenal ulcer.

Operations were performed in the main with the patient under spinal anesthesia. Slightly over 80 per cent had this anesthetic alone and the drug of choice was pontocaine. The other patients had various combinations of drugs. A cholecystectomy, or a combination of cholecystectomy and choledochostomy, was done in 92 per cent of the patients. The other patients had either a partial cholecystectomy and cholelithotomy or a simple cholecystotomy and removal of stones or a choledochostomy alone. And, as was stated above, 22 per cent of all the patients had common duct exploration and in that group 31 per cent were found to have stones. The presence or absence of stones in the common duct does not necessarily determine the presence of jaundice. Eight patients with common duct stones had no jaundice, whereas 14 patients who had no common duct stones were jaundiced at operation. Undoubtedly, some patients had passed stones before surgery was done, and it is certain that three stones were overlooked during common duct ex-

ploration. Cholecystostomy was done only four times in these 290 patients, which is strongly suggestive that preoperative preparation and the control of infection may practically eliminate such an operative procedure. However, there are instances in which it can be lifesaving and it is better to go back another day and remove the diseased organ than to go too far at the initial operation and have an operative mortality.

When the common duct has been opened and explored, it seems wise to use T tube drainage for 10 days or more, rather than be tempted to suture the common duct immediately. The probing and removing or searching for stones will certainly produce some edema and thereby produce a certain amount of obstruction. The advisability of draining or not draining the gallbladder bed seems to be one of individual preference. Convalescence is not prolonged and the abdominal wall is not weakened by such drainage. If a small rubber tissue drain is inserted and, if unrecognized accessory bile ducts are present, it is better to have the bile removed by drainage rather than have it puddle in the gallbladder area.

The most common postoperative complication was atelectasis or pneumonitis or a combination of both. This accounted for more than one-half of the postoperative difficulties. However, neither of these complications were listed as a cause of death. Other types of complications were very infrequent and certainly not statistically significant. Seven patients, or 2.4 per cent of the 290 patients that were operated upon, died while in the hospital. The cause of death was more often related to disturbances in the cardiovascular system than to anything else. Some of these deaths were no doubt preventable, as were the two deaths as a result of peritonitis. It is thus evident that primary surgery on the gallbladder and biliary ducts has become an increasingly safe procedure and certainly in the present series of patients mortality should have been lower than it was, because some of the deaths were apparently preventable.

SUMMARY

1. The surgery of gallbladder disease in 290 patients is discussed.
2. Eighty-eight per cent of these patients had stones in the gallbladder at operation.
3. Of the patients proved at operation to have stones, cholecystograms were accurate in 65 per cent.

4. Twenty-eight per cent of 151 patients with definite gallbladder disease demonstrated by cholecystograms showed other abnormalities, particularly in the duodenum.

5. The common duct was explored in 22 per cent of the patients and stones were found in 31 per cent of those.

6. The most frequent postoperative complications were atelectasis, or pneumonitis, or both.

7. The mortality rate was 2.4 per cent.

8. The most common cause of death was related to the cardiovascular system.

FACTORS IN MATERNAL MORTALITY IN SOUTH CAROLINA*

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THE statistics relating to births and maternal deaths reported annually by the Bureau of Vital Statistics of the South Carolina State Board of Health for the years 1941-1942 to 1950 inclusive, have been broken down into those relating to the counties of the Piedmont plateau and those of the coastal plain. An attempt has been made to correlate the statistical data with information that has been derived from studies by the Committee on Maternal Welfare of the South Carolina Medical Association of reports of individual maternal deaths during a period of approximately three years.

South Carolina is divided topographically into two rather distinct areas. There are in these two areas significant differences.

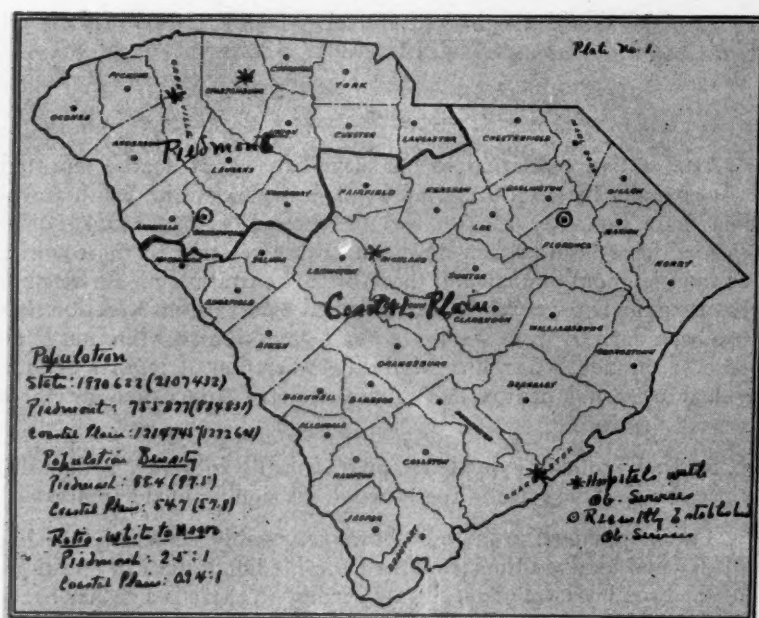
The map shown in plate 1 shows reasonably accurately the line of division between the counties of the Piedmont plateau and those of the broad coastal plain. In the Piedmont, there is a rather heavy concentration of industry, chiefly textile. Cities, towns and villages are closer together. This area occupies only 8,559 square miles, as compared with 22,035 square miles in the coastal plain. The population density of the Piedmont is 97.5, while that of the coastal plain is 57.8. The ratio of white to Negro population in the Piedmont is 2.5 to 1, while that in the coastal plain counties is 0.94 to 1.

Since this area is considerably industrialized, weekly payrolls, weekly spending and a more nearly uniform rate of income, not only for industrial workers but for other elements of the population, is the rule, and per capita income and wealth are greater and more uniform in the Piedmont than in the coastal area.

The availability of doctors is significantly greater in the Piedmont than in the lower part of the state. The 1950 edition of the "American Medical Association Directory" lists 559 doctors living in the Piedmont counties and 939 living in the coastal plain area. Of the latter, 233 live in Columbia, which is situated on the fall line, and 185 live in Charleston. Thus, only 521 doctors are available to the rural, village and small town people of the coastal counties. The ratio of doctors to population is 1 to 1493 in the Piedmont. In the

*A report by the Committee on Maternal Welfare, South Carolina Medical Association.

Presented during the Atlanta Assembly of The Southeastern Surgical Congress, Atlanta, Ga., March 10-13, 1952.

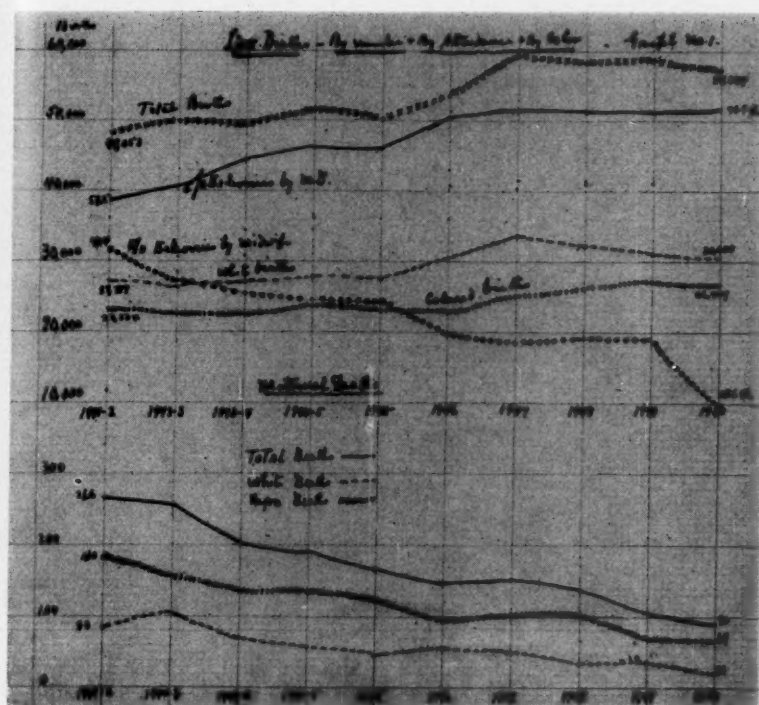


coastal counties, exclusive of the cities of Columbia and Charleston, it is 1 to 1,988. Perhaps more significant is the medical population density. In the Piedmont it is one doctor per 15 $\frac{1}{3}$ square miles, and in the coastal counties it is one doctor per 23 $\frac{1}{2}$ square miles.

Perhaps the availability of doctors, the more evenly distributed income, and the more than double ratio of whites to Negroes in the Piedmont, as compared with an almost equal division in the coastal area, all contribute to explain the fact that the number of births attended by midwives during the period 1942 to 1950 ranged from a high of 17.6 per cent to a low of 8.8, with an average rate per cent of 14.0 in the Piedmont, while in the low counties, the range was from 46.9 to 32.5, with an average rate per cent of 39.9.

The total number of live births per year in South Carolina during the decade has risen from 48,000 to 57,000 (graph 1). The lowest birth rate was in 1942-1943 when it was 24.8. The highest was in 1947, when it was 30.0. It is interesting to compare these rates with those of the U. S. registration area—about 18 before the last war, 25.8 in 1947 and about 24.5 in 1951. Our lowest rate is only 1 per 1,000 lower than the highest U. S. rate during the last 10 years.

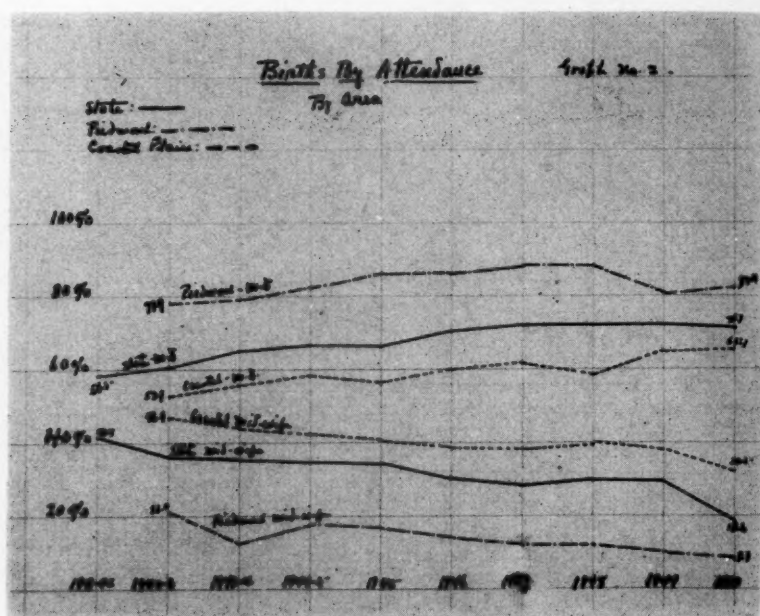
Our state white rate, based on white population, has risen rather steadily from 22.8 to 31.1. Our colored rate has varied rather



irregularly from 26.5 to 32. However, it has never been greater than 6 per 1,000 above the white rate.

The white birth rate in the Piedmont has been as high as 11 above the Negro rate in that area. The colored rate in the coastal counties has been as much as 6 per 1,000 above the white rate. It is statistically significant that the white birth rates for the state and for the larger of its two topographical areas are lower than the corresponding Negro rates; that the average white rate in the coastal counties is definitely lower than in the Piedmont; and that the Negro rate in the coastal counties is higher than the Negro rate in the Piedmont. The low country Negro, who is more isolated, more ignorant, more impoverished, more stoical and more superstitious than his up-state fellow, has more babies than does the Piedmont Negro.

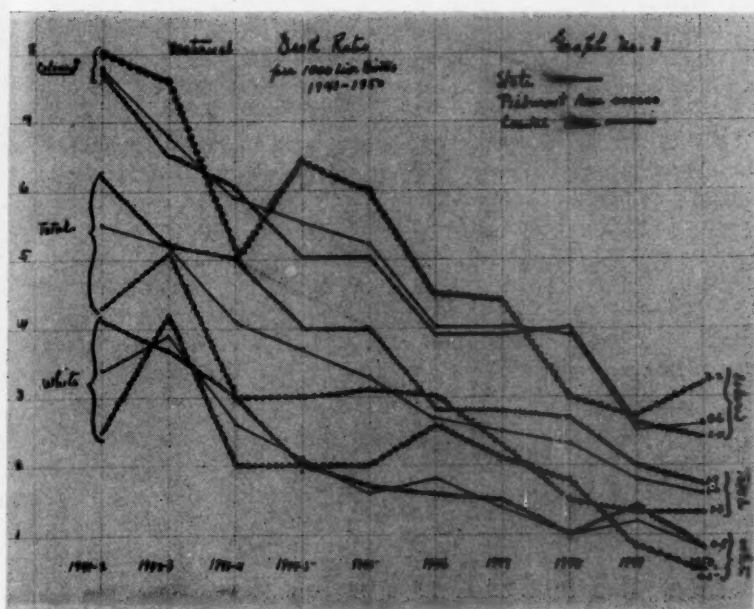
During the decade studied, deliveries by midwives have fallen from 41.4 per cent to 18.6. During the last four years, more than 50 per cent (57.1 in 1950) of all births have been in hospitals. The total number of births reported annually has increased approxi-



mately 1,000 per year. The total number of maternal deaths has dropped from 266 in 1941-1942 to 90 in 1950. These two facts have brought about a fall in the maternal death rate from 5.5 to 1.6. The line in the graph representing the death rate is almost a reverse incline to that representing the yearly number of deliveries by doctors. The lines indicating the yearly number of white and Negro deaths run roughly parallel. The number of white deaths has decreased nine-twelfths and that of Negro deaths has decreased approximately eight-twelfths.

Graph 2 is a study of births by attendance by area. This shows that medical attendance has increased along approximately parallel lines. The Piedmont rate in 1942-1943 was 20 per cent higher than the state rate and 30 per cent higher than the coastal rate. In 1950, the Piedmont rate was 11 per cent higher than the state rate and 17 per cent higher than the coastal rate. One third of all deliveries in the coastal area in 1950 were by midwives while less than one fifth of all deliveries in the state were so attended.

An attempt was made to correlate the statistical data relating to births to the number, causes, and distribution of maternal deaths. Graph 3 would be complicated except that the lines fall into three rather distinct levels. The lines indicating death rates for Negroes



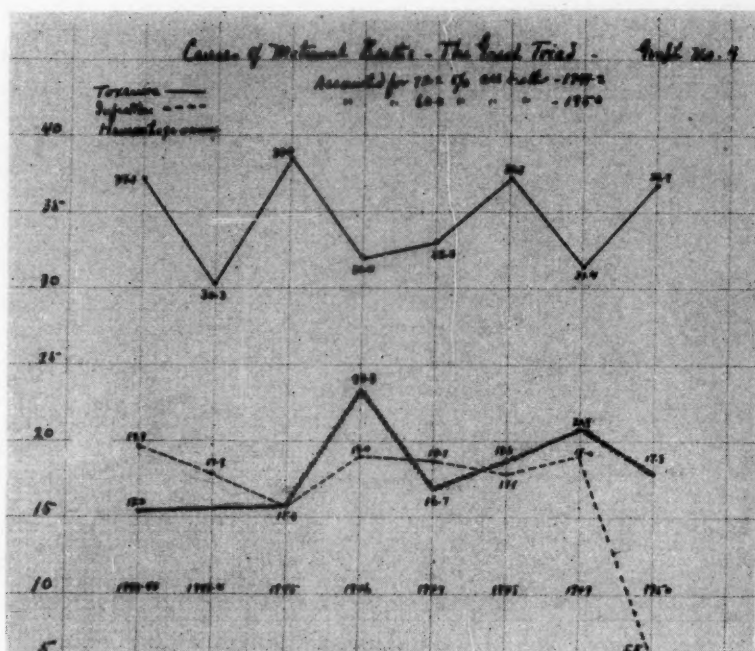
—state, Piedmont and coastal area rates—occupy the upper level. These lines all start at about the eight point level and end near the three point level.

The lines representing white death rates lie rather close together near the bottom of the graph area. They begin at the 2.5-4.5 level and drop rather uniformly to the 0.5-0.8 level.

The white rates average about 5 per 1,000 live births lower than the Negro rates throughout the 10 year period. The most uniform and consistent fall is in the white coastal rate—from 4.1 to 0.8. The next most consistent fall has been the coastal colored rate—from 7.8 to 2.4. The lines representing Piedmont rates are quite irregular. This is probably explained by the small number of deaths, which render the figures less statistically significant.

The respective roles of the three great maternal killers are shown in graph 4.

Toxemia has been the leading cause of maternal deaths in each of the six years where data are available. It has accounted for one third of all maternal deaths. Its highest rate was 38.8 per cent and its lowest was 30.3. In 1950, 36.7 per cent of all deaths were caused by eclampsia and preëclampsia, indicating that there has been no improvement in prevention or in cure of this complication of preg-



nancy. It is probably significant, however, that the average rate in the Piedmont was 36.1 per cent and that in the coastal area 41.2.

Hemorrhage as a cause of death ran a rather even course and yearly accounts for about one fifth of all maternal deaths. It is interesting to find that the average rate of deaths from hemorrhage in the Piedmont, where medical attendance is highest, was 23.5, while in the coastal area, where midwives have cared for more than one third of all deliveries, it was only 18.6 per cent.

Infection as a cause of maternal death has been reduced 50 per cent in both the Piedmont and in the coastal area, and in the entire state during the six years studied, the percentage was 19.0 in 1946 and 1949 and was only 5.5 in 1950.

Statistical data relating to other causes of maternal deaths are not presented in graphic or tabular form, but some mention will be made of them in the discussion.

DISCUSSION

The Negro presents our greatest problem in maternal mortality. His birth rate is higher, his use of midwives for delivery is greater, his prenatal care is usually nil or almost so. Toxemia of pregnancy

in Negro gravida is usually not recognized, or if recognized, it is not adequately treated until convulsions occur. Although deaths from toxemia are usually preventable, prevention is dependent upon careful medical supervision during pregnancy and institution of early adequate treatment after danger signs appear. Usually adequate treatment implies hospitalization, and the poorer and more ignorant and more isolated the patient, the more urgent is the need for hospitalization. To hospitalize these patients requires adequate hospital beds, and equally as important, provision to finance promptly hospital costs. Toxemia of pregnancy is an emergency condition even more pressing at times than acute appendicitis. The Negroes of the coastal counties are, with few exceptions, medically indigent. Hospitalization of indigent cases is not adequately provided for in that area.

There is another important pertinent factor in the high mortality from toxemia. Because of ignorance, stoicism, and superstition, these Negroes are slow to heed medical advice that entails expense or inconvenience.

It has been said many times that our maternal deaths do not occur in midwife cases. This statement is based upon the fact that only 20 maternal deaths are listed as having occurred without medical attendance during the last six years of the study. Eighteen of these occurred in the coastal counties. Midwives are taught to send for medical aid when complications are recognized. This they usually do. However, because of late recognition, poor means of communication and isolation, the doctor arrives usually when the patient is moribund or already dead. He signs the death certificate so that burial can be had, and assumes and is given in the statistical records responsibility for the death.

This practice results in another distortion of our figures. When the cause of death is not obvious and when it has been sudden or nearly so, death in too many instances has been ascribed to embolism.

The higher death rates in the coastal area are probably explained by the higher ratio of Negroes to whites, the higher incidence of midwife attendance, the lower population and physician densities, the greater distances to hospitals, the lack of facilities for prompt admission of indigent cases to hospitals, and the fact that there are not well organized obstetrical staffs in most community hospitals.

Deaths from hemorrhage present a problem. The number annually is nearly static. The incidence is greater in the Piedmont than in the coastal area. Questions suggested are: Is there a causal relationship between the higher incidence of deliveries by doctors and deaths from hemorrhage? Does the predelivery use of pituitary

extract play a part? Has obstetrical interference, especially in the third stage of labor, played a part? These are questions that the committee is unable to answer. It has found, however, several factors present in the series of deaths from hemorrhage. These are nutritional anemia, failure to recognize the potential dangers of blood loss, even when it appears to be insignificant, blood transfusions too little and too late—frequently due to lack of hospital facilities to give blood transfusions promptly, and in too many instances resort to surgery in patients already in profound shock from hemorrhage.

Deaths from infection have declined dramatically, probably because of the availability of sulfonamides and antibiotics. Deaths from ectopic gestation have decreased in six years from 8 per cent of all deaths to 3 per cent. It is believed by the committee that treatment of gonorrhea with the newer drugs has probably decreased the incidence of one child sterility, but has left a higher incidence of damaged tubes, with a resulting higher incidence of tubal pregnancy. Deaths of Negroes from ectopic gestation have ranged from $1\frac{1}{2}$ to 6 times those in white women.

There has been a steady decline in the number of deaths from abortion—from 22 in 1945 to one in 1950.

Our hospital facilities are rapidly improving. Up to November 1951, 851 additional beds had already been added, and 939 additional beds would become available when hospitals already under construction were completed. Four hundred beds were then in the planning stage.

The medical population of the state is increasing. Under current inflationary influences, more money is being earned and spent by our people. It will be interesting to see if these factors will tend to maintain or to lower still further our maternal mortality rate.

The Committee on Maternal Welfare plans to continue and to broaden its efforts directed toward the education of the doctors, of lay leaders of the colored population, particularly, and of the people regarding the necessity for careful medical supervision during pregnancy, the recognition, prompt and efficient treatment of abnormalities, and conservative management of labor.

SUMMARY

Results of a statistical study of births and maternal mortality

covering a 10 year period have been presented graphically and analyzed.

Causes of a significant decrease in maternal mortality, and the differences in causes and rates of mortality in the Piedmont plateau and in the coastal plain have been discussed.

PERINEAL PROSTATECTOMY

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WALTER STRODE, M.D.

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SINCE the original technic for perineal prostatectomy was first described by Hugh Young in 1906, gradually this method has become more and more widely accepted as one of the standard approaches to the diseased prostate. Although the technic has now been known for almost half a century, there was a long interval during which the method was used chiefly by those who had been trained either by Hugh Young or one of his disciples. The reasons for this slow acceptance were, first, a rather disturbing incidence of postoperative urinary incontinence, even in the hands of those thoroughly familiar with the technic, and secondly the intricacies of the technic, which made it somewhat difficult to master. However, the modifications in the technic devised by Belt¹ in 1939 did much to help popularize the method. These improvements almost entirely eliminated the danger of incontinence, somewhat shortened the convalescence period and considerably reduced the incidence of postoperative bleeding and morbidity by accurate hemostasis and restoration of the continuity of the bladder neck and urethra by means of accurate suturing under vision. Since this procedure offers a safe surgical method by which early carcinoma of the prostate can be cured, it has become generally recognized as one of the basically important urologic technics with which every urologist should be familiar.

Notwithstanding the dramatic results of hormone therapy in carcinoma of the prostate, now familiar to all since the contributions of Huggins^{2,3} a scant decade ago, unfortunately this method is still only palliative. Just as in malignant lesions in every other part of the body, radical surgical extirpation offers the only chance for cure of early cancer of the prostate. This can best be accomplished by the perineal approach, since it not only is safe and convenient but also provides an opportunity for exposure and biopsy of suspicious nodules in the posterior capsule, making it possible to determine accurately those requiring radical operations and sparing those on which results of biopsy are negative. Finally, the operative mortality and morbidity compare favorably with those of the other three methods.

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INDICATIONS

The most important indication for perineal prostatectomy is early carcinoma of the prostate. This is the commonest malignant lesion in men over 50 years of age; next to carcinoma of the stomach and rectum, it is the commonest cause of death from cancer in males.

Moore⁴ made careful studies of his routine autopsies in men past 40 years of age and observed that of the early prostatic carcinomas whose origin could be determined, 73.5 per cent arose in the posterior lobe, 8.8 per cent in one lateral lobe, and 14.8 per cent in the anterior lobe. Only 2.9 per cent of prostatic cancers originated in areas of benign hypertrophy. These figures indicate clearly that the majority of these lesions begin in the posterior lobe, are easily palpable rectally, and, therefore, could be diagnosed early. Unfortunately, however, only about 5 per cent of cases of carcinoma of the prostate are discovered at a time when they are still amenable to radical surgical extirpation. This is due, of course, to the fact that the disease gives no indications of its existence until it produces either urinary obstruction or metastatic symptoms by which time radical cure is obviously impossible.

Various benign prostatic lesions also lend themselves well to perineal prostatectomy. Because of its low morbidity in cases considered poor surgical risks, the perineal approach is believed by some to be the method of choice in large benign hypertrophies in which transurethral resection is not feasible depending upon the size of the growth. In addition, extreme obesity, previous suprapubic surgical operations or the presence of large hernias in patients with large benign hypertrophy sometimes make either suprapubic or retropubic prostatectomy undesirable; in such situations the perineal approach is ideal. This approach is also indicated in some instances of deep-seated chronic prostatitis, with or without calculi, in which the disease involves the capsule and is, therefore, not amenable to complete removal by transurethral or subtotal prostatectomy. In such cases this approach offers an ideal means, with expectation of cure, for complete removal of the entire prostate and its capsule, including all infected and calculous areas. Familiarity with the perineal approach also makes it possible to obtain successful closure of recto-urethral fistulas by this method in a high percentage of cases.

TECHNIC

Young's original technic has been modified by several operators. However, Belt's^{1,6} modification has been more widely accepted than any other and has been used exclusively by us, since it appears to offer a significant number of advantages over any other method.

Spinal anesthesia is used whenever not contraindicated. The patient is placed in the extreme lithotomy position, with or without the use of a special perineal board. When the patient is in position, the perineum should be as nearly parallel to the floor as possible. A rubber dam is clipped over the anal area before the patient is draped. A curved incision is made from one ischial spinous process to the other, 1.5 cm. above the mucocutaneous anal border. This incision should be bold and deep, so that the few fine vertical fibers of the perineal raphe are cut, and the arching fibers of the external anal sphincter are exposed. The posterior lip of the wound is depressed with the finger and the handle of the knife is introduced between the borders of the anal sphincter and the rectum, so as to separate these fibers from the rectum. The anal sphincter is then retracted out of the field of vision by two lateral retractors. The posterior retractor is inserted to depress the rectum. A sound is passed into the bladder and then manipulated in such a way as to push the prostate forward in the wound. The tough, fibrous median borders of the levator ani muscles are then separated by blunt dissection; this exposes the glistening fascia covering the posterior portion of the prostate. If subtotal enucleation of the prostate is contemplated for benign hypertrophy, no further dissection is necessary. An inverted U incision is made in the capsule, the sound is removed, the urethra cut completely across with scissors near the apex of the prostate, and with the aid of a prostatic tractor the adenomatous hypertrophy is enucleated in the usual manner. The bladder neck is then brought into the field of vision and four hemostatic sutures are taken around its circumference, after which the bladder neck is accurately resutured to the distal urethra over an indwelling Foley catheter. The capsule is then closed with interrupted catgut sutures, the levator ani borders are reapproximated, and the skin is sutured with catgut.

In the radical procedure, after the prostate proper has been exposed, Denonvilliers' fascia is incised vertically, the prostate is more completely dissected laterally, and at its base the bundle of vessels entering the prostate at each inferior lateral angle is freed, clamped and secured by transfixion ligature. The seminal vesicles are then exposed and dissected free, together with a long portion of the vas deferens. The vessel entering the tip of each vesicle is ligated. The apex of the prostate is then cut across at the membranous urethra, and the gland is pulled down and carefully dissected free from the venous plexus lying anteriorly. It is then cut free from the bladder neck with scissors, after which the same steps in hemostasis and anastomosis of the bladder neck to the urethra are carried out. The superficial fascia is then restored as the second layer covering the

anastomosis of the urethra and bladder neck, and the wound is closed as described in the preceding paragraph.

COMPLICATIONS

Bleeding rarely occurs after perineal prostatectomy because of the excellent exposure and direct visualization of bleeding points and the use of hemostatic sutures around the circumference of the bladder neck. Postoperative urinary incontinence following the Belt technic is extremely rare. In over 100 prostatectomies performed by us on the Tulane University Service at the New Orleans Charity Hospital and the Ochsner Foundation Hospital we have had no cases of incontinence with the exception of stress incontinence of a mild degree for three to six weeks postoperatively in several cases, but this also occurs after any other method. Belt⁶ reported no cases of incontinence following 50 radical prostatectomies. A review of the literature reveals an average incidence of 12.2 per cent of permanent incontinence of urine following a total number of 540 cases done by the older methods of perineal prostatectomy. It is generally agreed that the relatively high incidence of incontinence following the older methods was due both to actual exposure of the external urethral sphincter to physical damage during the procedure and to disturbance of its nerve supply during exposure of the prostate. In the technic described herein, the prostate is approached along the rectal plane throughout and at no time is the external sphincter exposed nor is any dissection carried out in an area likely to damage its nerve supply.

Rectocutaneous or rectourethral fistulas occasionally develop following perineal prostatectomy by any technic. Virtually all cases of rectal injury occur during the initial steps of the procedure. Any small opening made in the rectum near the rectocutaneous junction may be immediately sutured and the procedure continued. Only those openings in the rectum higher up at approximately the level of the prostate create the risk of permanent urethrorectal fistula. We have had one such complication of the latter type in our series which was corrected surgically about four months following the perineal prostatectomy, by means of the identical approach employed for the prostatectomy. In several other cases, alluded to earlier, there was temporary leakage of feces through the incision postoperatively, all of which, however, closed spontaneously during the immediate postoperative period in the hospital and did not actually delay convalescence appreciably.

RESULTS

The immediate operative mortality following perineal prostatec-

tomy compares favorably with that following other open procedures employed for prostatectomy. Several series reported in the literature recently show a mortality ranging from 3 to 5 per cent. In our own series of over 100 cases there was one death which resulted from sepsis due to confusion in the management of the postoperative catheter drainage, which in turn permitted considerable extravasation of urine to occur extraperitoneally without adequate drainage.

TABLE 1

Results of Radical Perineal Prostatectomy in Early Carcinoma of Prostate

<i>Author</i>	<i>Patients</i>	<i>Per Cent 5 year survival</i>
Belt (6)	50	58.0
Smith (5)	—	30.0
Hinman (7)	45	56.5
Jewett (8)	190	51.3
Twinem (9)	84	55.0
Colston (10)	—	48.2

Reported five year cures for early carcinoma of the prostate following radical perineal prostatectomy are now accumulating in the literature in sufficient number to present an impressive picture. As will be seen in Table 1, about one half of those patients with early carcinoma of the prostate treated by radical perineal prostatectomy have survived five years without evidence of recurrence. This is about the same as the usual percentage of three years' survival of patients with inoperable cancer of the prostate subjected to all forms of modern hormone therapy, including orchiectomy, oral administration of the hormones, and palliative transurethral resection to relieve urinary retention. Nesbit¹¹ reviewed a series of 1818 patients with inoperable carcinoma of the prostate treated by either oral administration of hormones, orchiectomy, or a combination of these. Of the entire series 947 were followed three years, of whom 54.2 per cent were alive at this time. Of 587 patients followed five years, 26.9 per cent survived. It is indeed unfortunate that at the present time only 5 per cent of cases are discovered early enough to be given the benefit of radical surgical treatment; it is to be hoped that this figure will increase as the importance of routine examination of the prostate in all men over 50 years of age becomes generally appreciated.

CONCLUSIONS

Perineal prostatectomy for both benign and malignant disease

of the prostate now occupies an extremely important place in urologic surgery and offers the best method for completely eradicating early cancer of this organ. Improvements in the technic of perineal prostatectomy in recent years, particularly the modifications proposed by Belt, have virtually eliminated the serious postoperative complications which heretofore have led to only limited acceptance of this procedure. The percentages of five year survivals following radical perineal prostatectomy for early carcinoma of the prostate obtained in recent years point up the necessity for every urologist to be prepared to offer this procedure to any patient in whom the condition is discovered early enough to be operable, even though, unfortunately, at present only 5 per cent of the total number of cancers of the prostate seen are operable. Because of the low mortality and low morbidity associated with this approach its use is also recommended for various nonmalignant diseases of the prostate and the perineum, including subtotal prostatectomy for large, benign hypertrophies, complete prostatectomy for intractable chronic prostatitis, with or without calculi, involving the capsule, and repair of recto-urethral fistulas.

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SURGERY FOR PERIPHERAL ISCHEMIA

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PERIPHERAL ischemia results from organic or physiologic changes affecting arteries. A satisfactory classification based on etiologic factors is as follows:

- I. Arteriosclerosis
 - A. Senile
 - B. Diabetic
- II. Thrombo-angiitis obliterans
- III. Embolus and thrombosis
- IV. Injury
 - A. Contusion of an artery
 - B. Laceration or severance of an artery
- V. Aneurysm
- VI. Post-traumatic vasospasm (Sudeck's atrophy; causalgia; pneumatic hammer disease)
- VII. Raynaud's disease
- VIII. Frostbite
- IX. External pressure (exostoses; other tumors; Baker's cyst; cervical rib; (scalenus anticus)
- X. Chemicals and drugs (ergot, lead, irradiation)
- XI. Intravascular choking (polycythemia; leukemia)
- XII. Blood volume flow disturbances (anemia, shock)

Arteriosclerosis is the most common of all vascular diseases. Its incidence is increasing rapidly since the average age of the population is older and the number of people in the seventh decade and beyond is increasing. To a certain extent, it is physiologic. Appearing soon after birth (tiny atheromas may be found in the aorta in infants), it increases proportionately to age and may be expected as a normal process if its severity is not exceptional for a particular age. Sex, occupation, habits, race, familial tendency, hypertension, diabetes, and numerous other factors influence its development. The last three are frequently encountered causes. Indeed sugar and lipid metabolic disturbances are more and more likely to be incriminated as the disease is better understood.

Arteriosclerosis of the senile type may differ in some respects

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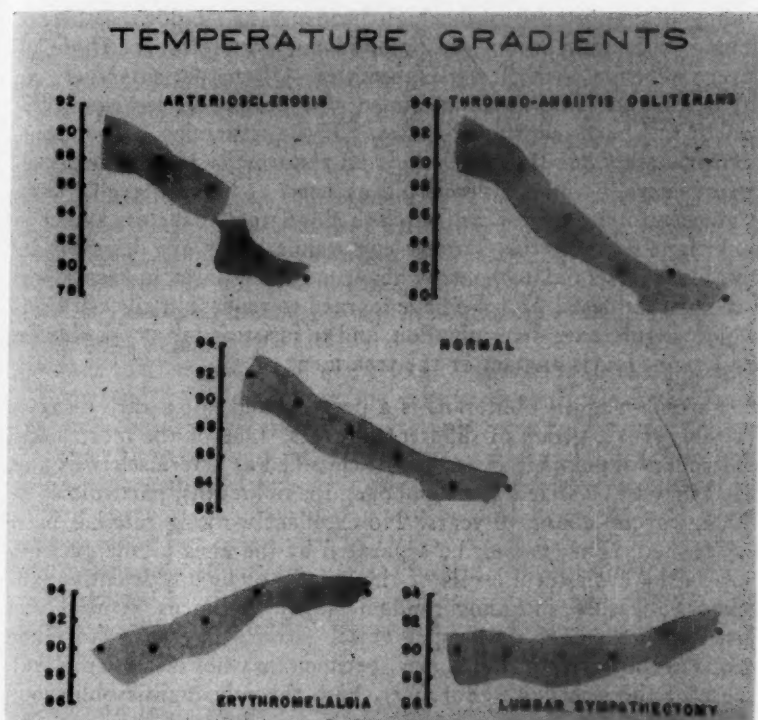


Fig. 1. Diagrammatic representation of temperature gradients in the leg. In the normal leg there is a gradual fall-off from 92 F. to about 84 F. from above the knee to the toes. In thromboangiitis obliterans, this gradient is steeper, and the decline is greater. In severe arteriosclerosis with impending gangrene, there is often a break in the gradient, a sudden chilling, a fall-off of several degrees from one level to the next. After lumbar sympathectomy, the gradient is often reversed; that is, the temperature of the toes is greater than just above the knee. This is a good prognostic sign, and it is often a permanent improvement. In erythromelalgia, a rare vascular disease, the skin temperature gradient is reversed from the normal; it is up-graded.

from diabetic arteriosclerosis, but it is difficult to show any pathologic distinction at the operating table. Thickening and calcification of the intima and encroachment on the lumen may be found in both types, and apparently sudden increases in ischemia in these states may be occasioned by a clot occluding the vessel at the site of a broken atheroma. One important clinical effect of this type of sclerosis is rigidity and loss of resilience in the vessels affected; yet at the same time numerous collaterals may be capable of undergoing extensive and effective vasodilatation.

Hyperglycemia itself, apparently, is a vasospastic stimulus. A

finding of importance is the high incidence of "hidden diabetes" among patients in whom the predominant symptoms are those of severe ischemia in the lower extremities. Of the patients over age 50 years who come under treatment for peripheral ischemia, one fourth will have manifest diabetes. Of the remaining 75 per cent, approximately one third will show an abnormally high glucose tolerance curve, with or without spill of sugar at highest levels. Only a glucose tolerance test will disclose this latent diabetes, and it is important to know this because euglycemic levels are desirable or absolutely essential to control abnormal vasospasm in peripheral ischemia (tables 1, 2). We have learned to request in all such cases a glucose tolerance determination, and to insist as far as possible on euglycemic levels as part of the treatment.

Thromboangiitis obliterans is a peculiar and not a rare disease. Possibly it is a group of different diseases. One of the most justly controversial points is what may be classified as arteriosclerosis and what may be classified as thromboangiitis obliterans, particularly in the age group above 40 years. No excellent working rule has been established. They cannot be separated by the ages of the patients nor by the cholesterol levels of the blood nor by any scientific laboratory measure, including random biopsy specimens. Unless one just happens to get the proper vessel (which may be disadvantageous to the patient), the biopsy specimen may not disclose the true cause of the ischemia. Moreover, both thromboangiitis obliterans and arteriosclerosis may occur simultaneously, and both may be partial factors in the clinical picture. We have learned to depend largely on age, color changes (more lividity in arteriosclerosis, more erythromelia in thromboangiitis obliterans), the firmness of the vessels in other parts of the body, and on direct exposure and examination of the iliac arteries and the aorta at the time of sympathectomy. The latter procedure can give excellent evidence for or against arteriosclerosis.

Ischemia severe enough to cause absence of peripheral pulses and impending gangrene in the absence of other obvious cause such as trauma or pressure on a vessel is the result of arteriosclerosis if roentgenograms of the extremities show calcification of the arteries. However, absence of roentgenographic evidence of calcification is not such good evidence that arteriosclerosis is not the cause of the ischemia. At times, clinical differentiation of the two diseases may be extremely difficult or impossible.

Thromboangiitis obliterans can be typical with the purplish-red erythromelia, claudication pain, the "rest" pain at night, and absence of pulses occurring in a young male. The erythromelia or

purplish-red discoloration is the most characteristic objective finding. It more rarely occurs in arteriosclerosis where lividity even on dependency is more likely. The blanching on elevation is found in both diseases and the tardy return of color to the feet, but the reactionary rubor is typical of thromboangiitis obliterans and the persistence of lividity in arteriosclerosis. The symptoms and findings in thromboangiitis obliterans may be bizarre, so far from the prototype that one just knows it is a different disease. There are probably a number of conditions now included under this term which are entirely different diseases, unrelated except in their effects; however, as yet, apparently no one has had the experience or acumen to distinguish and separate them. They are often closely fused; possibly they are different intensities of the same disease merging at one end of their acromatic spectrum with arteriosclerosis. Thromboangiitis obliterans in youth is often a fulminating violent disease. At a later age, in the fifth and sixth decades, it is slow and not so destructive. It is a self-limiting disease with progression for two or three years; then it tends to become quiescent, and if the patient stops smoking and if he can be tided over the active stage of the disease without loss of limbs, often, although the disease has compromised his circulation, it may remain good enough for a productive working life without fear of further exacerbation.

TABLE 1

Mrs. L. W. K., aged 66. Cold hands and feet, severe impending gangrene, right foot. Urine negative. Blood sugar 105.

<i>Glucose tolerance</i>	<i>Blood</i>	<i>Urine</i>
Fasting	108	Negative
½ hour	160	Negative
1 hour	234	Negative
1½ hours	266	Negative
2 hours	286	Negative
3 hours	186	Negative

Hidden diabetes is very common in severe ischemic states. In spite of single fasting blood sugars within normal range and repeatedly negative urine tests, it may be present. It can be disclosed only by requesting a glucose tolerance test. The data represents a finding in a 66 year old woman with impending gangrene of the right lower extremity. She had had excellent medical care by an outstanding clinician and never had any tendency to diabetes been noted. Because of the ischemic state, a glucose tolerance test was requested, and the extremely high curve is noted. It is very important to keep the blood sugar within reasonably normal range in such a patient because hyperglycemia itself is a factor in vasospasm.

The treatment of the above conditions may be properly discussed together. Treatment may be divided into physioclimatic control, drugs, alleviation of causes, and direct and indirect surgical measures to increase the blood flow. Obviously the removal of the cause

is most desirable, but this is not always feasible. If it is pressure from bony tumor or cervical rib, removal may give dramatic results. The main objective is to obtain better blood supply to the extremity. The control of hyperglycemia has been mentioned. Additional non-operative measures include temperature regulation and drugs. Temperature of the extremity may be protected by proper clothing and avoiding exposure to undesirable environmental changes. The optimum environmental temperatures are between 75 and 80 F. Anything lower than 75 F., certainly 70 F. and below, tends to produce vasospasm; anything above 90 F. increases the metabolic demand in an extremity already suffering from too little blood supply. Chilling the extremity may reduce the pain of ischemia, but if you pack ice bags around a foot which is ischemic, tell the relatives you have given up and that you expect to amputate the extremity. Such treatment may mitigate the patient's subjective symptoms, but it always makes the ischemia worse and is contraindicated except as icing for refrigeration anesthesia.

TABLE 2

Mrs. M. D., aged 82. Arteriosclerotic ischemia burn ulcer, left great toe. Urine negative. Blood sugar 108.

<i>Glucose tolerance</i>	<i>Blood</i>	<i>Urine</i>
Fasting	113	Negative
½ hour	165	Negative
1 hour	200	Negative
2 hours	226	Negative
3 hours	241	Negative

Another example of hidden diabetes in an 82 year old woman who two months before had been on a gynecologic service in the hospital and had suffered a hot water bottle burn of the left great toe which failed to heal because of the severe ischemia due to arteriosclerosis. Diabetes had not been suspected before the vascular problem became paramount. A glucose tolerance test revealed the above findings.

Drugs may be used, but in my experience without the hope of permanent remarkable benefit. Perhaps the three best are priscoline, tetraethyl ammonium chloride (etamon), and intravenous alcohol or ether. Each of these does have some vasodilator effect, but it is transient and evanescent and cannot be maintained at effective levels without undesirable side effects. The vasodilatation is not just where you want it. It is systemic and not selective for the ischemic leg.

Among the most effective of all measures for ischemia is release of the vasoconstrictor influence of the sympathetic nerves by interval procaine nerve blocks and by sympathectomy. Its effects are truly remarkable.

There are several means of estimating the expected improvement before an operation. Oscillometers, in our experience, have not been nearly as helpful as the electric skin thermometer. The oscillometer is sensitive all right. It does give selective help in locating the lodgment of an embolus and the absence of blood volume pulse in the leg, but it is less helpful as a means of estimating changes in vasodilation before and after nerve block and sympathectomy. So many factors influence it, including muscle movement, the exact position of the cuff, the adjustments on the machine and position of the oscillating needle, it is difficult to keep even two consecutive readings under the same standards. Plethysmographic studies are difficult and require equipment which is not easily movable. It has never

TABLE 3

M. W., aged 52. Intermittent claudication, left leg, $\frac{1}{2}$ block. Left lumbar sympathectomy 1/10/50.

	Preoperative		After block	9 Days Postoperative		3 Weeks Postoperative
	Right	Left	Left	Right	Left	Left
Thigh	89	85	94	89	89	91
Below knee				87.5	89.5	91
Mid leg	90	90	95	89	92	90.75
Ankle	90	87	92	89.5	90.5	90.5
Dorsum foot	91	87.5	95	91.5	91.5	
Great toe	87	84.5	92.5	87	92	92
Fifth toe	86	83.5	93	85.75	90.75	92

Skin temperature studies. A man aged 52 years had intermittent claudication and objective evidence of severe ischemia in the left lower extremity. The diagnosis was thromboangiitis obliterans, or arteriosclerosis. Note that after procaine block the rise of temperature in the toes was almost 10 F. Left lumbar sympathectomy resulted in an improvement of the circulation in the foot so that the skin temperatures from the thigh to the toes were "up-graded." He could walk half a block without pain before operation and four blocks after operation. Pulses were not detectable for the left posterior tibial and dorsalis pedis arteries.

been perfected for routine clinical use. Lumbar sympathetic nerve blocks with procaine and determination of the skin temperatures before and after the block may reveal a remarkable rise in the temperatures even in ischemic states which are severe enough to cause intermittent claudication and which are accompanied by absence of both the dorsalis pedis and posterior tibial pulses. Even under such conditions, the temperature rise in the toes after sympathetic nerve block may be 10 F. What will be the rise in the temperature of the toes after nerve procaine block or after sympathectomy in thromboangiitis obliterans with claudication after walking two blocks and with pulses of both the dorsalis pedis and posterior tibial arteries absent? It may be as high as 10 F., and this rise may be maintained

indefinitely with the pulses never returning, remaining absent, but with remarkable clinical improvement. Table 4 indicates the readings in a man aged 46 years who had claudication on walking one half block. He would then have to stop because of pain in the left leg. One year after left lumbar sympathectomy the foot and toes are warm; 9 F. warmer than those of the opposite leg; and the skin temperatures of the leg are "upgraded," that is, the temperatures rise toward the periphery.

The leg skin temperatures have a normal down-gradient. Temperatures vary but from the lower thigh to the foot in 75 F. environment, the normal variations are approximately as follows:

Thigh 92. Below knee 90. Mid leg 88. Ankle 86. Dorsum foot 84. Toes (1, 2, 3, 4, 5) 84.

Ischemia affects these readings tremendously. The pattern is changed so that in severe arteriosclerosis there may be a sudden sharp fall-off in the gradient of 4 F. or 5 F. (fig. 1). Such a "break" in the gradient is of bad prognostic import whatever the cause of the ischemia. Release of the sympathetic nerve influence may reverse the gradient. Instead of the temperatures falling from the thigh to the toes, they rise. If the gradient can be reversed by nerve block and sympathectomy, the prognosis is good. Note that the reversed gradient in the patient's readings in tables 3 and 4 have remained "upgraded," one for a year after operation. This tendency to peripheral vasodilatation persists after sympathectomy in the upper as well as in the lower extremity. If upper dorsal sympathectomy is done for causalgia affecting the arm, the hand remains warm in our experience for years, but this is not likely if it is done for Raynaud's disease. Lumbar sympathectomy for Raynaud's disease probably results in the same tendency for return vasospasm in the feet as the operation for the same disease in the upper extremity. The fact is that most sympathectomies for upper extremity ischemia are done for Raynaud's disease and most lumbar sympathectomies are done for other conditions. In our experience, the tendency to recurrent vasospasm in the upper extremity is found in Raynaud's disease but not when the operation is done for causalgia. The difference is in the disease.

The diagnosis of thromboangiitis obliterans is the indication for sympathectomy. The improvement following sympathectomy in diabetic and early senile arteriosclerosis, or, perhaps better expressed, senile arteriosclerosis at an early age, may be equally as dramatic and wonderful as it is in thromboangiitis obliterans. To be sure, improvement may fail to follow in any of these conditions

but sympathectomy is the most powerful measure we have to obviate ischemia in arteriosclerosis and thromboangiitis obliterans.

Perhaps judgment as to which patients with arteriosclerosis obliterans should be offered sympathectomy is as indefinable as judgment itself. One of the soundest criteria is the appearance of the patient; if confusion and tardiness in cerebration indicates that his cranial blood supply is as badly impaired as the claudication indicates the blood supply of the leg to be, then sympathectomy would be ill-advised. His nutritional state, strength, and the general impression he gives, indefinable as it may be, is a very good one and perhaps the best guide.

TABLE 4

M. W., 1 year after left lumbar sympathectomy (1/17/51). No pulses, left foot. No claudication after walking 4 blocks.		
	<i>Right</i>	<i>Left</i>
Thigh	86	89
Below knee	88	90
Mid calf	87.5	89.5
Ankle	86	91
Dorsum foot	88.5	92
Great toe	85	92
Third toe	85	92.5
Fifth toe	83.5	92

The temperature readings in the skin of the lower extremities in the same patient whose data is presented in table 3 one year after left lumbar sympathectomy. Note that the left foot still remains warm although there are no pulsations in the dorsalis pedis or posterior tibial arteries. The gradient of the skin temperatures is still reversed; that is, the foot is warmer than the thigh and it remains warmer than the opposite foot which clinically has not shown signs of ischemia. The patient who quit smoking is in excellent condition and is able to work and lead a normal life. This remarkable improvement following sympathectomy is not exceptional but is to be expected when it is done for thromboangiitis obliterans and arteriosclerosis provided the patient is not in an advanced age.

There are a few remarks I wish to make about the actual operation itself. Of course, sympathectomy for ischemia of the upper extremity is not nearly as commonly indicated as it is for the lower extremity. However, in certain cases of thromboangiitis obliterans, post-traumatic ischemia, Raynaud's disease, causalgia, and Volkmann's ischemia, it is indicated. My own preference is for an anterior approach and for preganglionic sympathectomy, mainly because the latter preserves intact fibers of the eye and prevents Horner's syndrome. A discussion of the extent of sympathectomy necessary and the type necessary to prevent recurrence of vasospasm in the upper extremity is deliberately avoided.

There are a few remarks which I should like to make about the

technical aspects of lumbar sympathectomy. The proper position of patient on the table is very important and extremely helpful. Good anesthesia with excellent relaxation, avoiding the resistance the abdominal musculature might otherwise make, is extremely advantageous. Therefore, spinal anesthesia is the optimum anesthetic for this operation. As I indicated in a previous paper, the best position for the patient is on his side, tilted back about 35 or 40 degrees from the vertical. The approach through the transverse incision from the eleventh rib forward to above the umbilicus is a very easy one. The peritoneal sac freed from the abdominal wall with the patient in this position falls away to the opposite side, and it is not difficult to expose the sympathetic chain. It is well known that there is a great variation in the number of ganglia in the lumbar chain. It is not feasible to take out a definite two or three. For that reason, some rule or landmark should be had in order to get the chain from the second vertebral level down through the fourth. I formerly did this by placing needles posteriorly, inserting them at the level of the second transverse process and at the level of the fourth, with the patient in position on the operating table, and letting them remain there until they are exposed anteriorly in the paravertebral gutter. In this way, it was possible to learn that in order to get sufficiently high on the second vertebra, it is necessary to cut the fascial covering between the psoas muscle and the crux of the diaphragm. The nerve chain is removed from this level. It is easier below because one can feel the promontory of the sacrum and the divergence of the iliac arteries. Thus, the chain may be removed from the second through the fourth or fifth lumbar vertebra regardless of the number of ganglia on it. Extreme care should be used not to exert too much trauma in displacing the arteries and the psoas muscle in this operation. Otherwise, traumatic neuritis, a troublesome postoperative complication of which patients sometimes complain very severely but which always clears up spontaneously after a period of weeks, may result. If one traumatizes the artery and displaces it widely, particularly in arteriosclerotic states, little atheromatous plaques may be kicked off and act as emboli; and not only will the sympathectomy under these circumstances not be helpful but it may be injurious since the embolus may result in gangrene. The occurrence of more severe ischemia following sympathectomy, I believe, may usually be accredited to this factor.

There are some other procedures which, if properly developed, may give some additional hope for improvement in the surgical management of these conditions in the future. With two of these

we have had some experience—endarterectomy, and transplantation of frozen homologous arteries.

Endarterectomy has been performed by us in 5 patients. It consists of making incisions in the vessel and removing the calcified atheromatous plaques. They come out easily and leave a smooth, wide lumen. The openings in the vessel are then closed and it pulsates. Incisions into the vessel may be made at multiple levels—popliteal, femoral mid thigh, femoral upper thigh, and iliac vessels, but the disease is extensive and we have lost three extremities in five tries. One of these may have had a viable extremity with the sympathectomy alone. Lumbar sympathectomy has routinely been performed simultaneously. The combined procedures are feasible with the patient on the side and the affected leg draped out into the field. The difficulty is that the calcified intima goes on endlessly and where it is finally broken off conditions are excellent for blood to get behind it and, in effect, form a dissecting aneurysm. The result may be a worsened instead of an improved circulation.

Transplantation of vessels is now feasible. Following the method of Paul Schafer, we have been able to replace successfully segments of the abdominal and thoracic aorta in dogs with homologous frozen grafts. Dr. Schafer's splendid contribution includes the use of a temporary shunt of the blood from the proximal to the distal segments of the aorta through a polyethylene tube while the aorta is being resected and the new segment is being sewed in place. This temporary shunt is absolutely necessary, otherwise the dogs become paralyzed if the aorta is transected and the flow of blood through it is interrupted even for brief periods of time. The grafts remain patent and stay viable. This certainly will open up new possibilities for replacing localized segments of the aorta and other vessels in the lumen. Unfortunately, it will be less useful in widespread arterial disease such as arteriosclerosis obliterans.

SUMMARY

A classification of peripheral ischemia based on etiology is presented.

The high incidence of latent diabetes in patients with ischemia due to arteriosclerosis obliterans and the necessity for keeping blood sugar at euglycemic levels is discussed.

Certain clinical features of arteriosclerosis obliterans are discussed as well as technical points of sympathectomy and exposure of major arteries at the same time.

Brief comment is made on endarterectomy and the experimental transplantation of homologous grafts.

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2. Schafer, P. W., and Hardin, C. A.: Use of temporary polythene shunts to permit occlusion, resection and frozen homologous graft replacement of vital vessel segments, *Surgery* 31:186 (Feb.) 1952.

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WHY DO PATIENTS DIE FOLLOWING ANESTHESIA?

The number of deaths associated with and following anesthesia each year in the United States is unknown. It has been estimated by the Federal Security Agency that during the year 1950 over 8,000,000 operations were performed for which anesthesia was required. In a recent survey 513 deaths were reported following 763,469 operations with a mortality ratio of 1 to 1,488. Utilizing the above figure from the Federal Security Agency this gives us 5,376 plus deaths following anesthesia and surgery. This figure in itself is misleading for it is an impossibility to estimate how many deaths occurring in the postoperative period were contributed to by the anesthetic.

Deaths attributable to anesthesia are difficult to justify and explain, particularly to lay people. Most operating room deaths occur in patients whose only hope for life is surgery; but far too great a number occur, following minor surgical procedures of little consequence, to justify a feeling of complacency. There is an occasional patient who is so seriously ill that regardless of the skill of the anesthesiologist and surgeon a fatality will occur.

Technical surgical errors are involved in a small percentage of

cases. These too are accepted as inevitable in any large series of cases; but the most discouraging moments in surgery are those when the patient dies as a result of the anesthetist's error in technic or judgment due to carelessness, inattention, ignorance or incompetence.

As to the cause of these deaths a good deal of reliable information may be obtained from a summary of 11 years' activity by the Anesthesia Study Commission of the Philadelphia County Medical Society. Forty-seven per cent of the fatalities were judged by the Commission as preventable, 38 per cent nonpreventable and 15 per cent were undetermined from lack of information or decision. Overdosage of the anesthetic agent and hypoxia head the list as probable causes of preventable deaths. The occurrence of such deaths, since they are preventable, naturally reflect upon the ability of the anesthetist and his interpretation of basic physiological signs.

The utilization of half a dozen or more agents, or "polypharmacy anesthesia," under the guise that the administration of minimal quantities of each reduce the toxic dosage of each agent is based upon fallacious and unscientific reasoning. Such admixtures have been reported as approaching the ideal anesthetic. Why should it be considered necessary to give pentothal, curare, nitrous oxide, cyclopropane, ether, procaine intravenously and local infiltration for the ideal anesthetic? This question has a definite answer: it is not necessary.

The condemnation of an agent as the cause of death is still too frequently quoted as the responsible offender. Cyclopropane has been condemned unmercifully by anesthesiologists, surgeons and internists alike as being unsafe, while ether, the "so-called safest anesthetic," which has been responsible for just as many deaths, has been uncriticized. Such condemnation of agents is unjustified and the responsibility should be placed upon the person at the head of the table.

Deaths following subarachnoid analgesia, because of respiratory paralysis, are due to too high a spinal block; these deaths are inexcusable and preventable. Maintenance of the oxygen and circulatory transport systems with adequate pulmonary ventilation, until the agents are detoxified and eliminated, which they surely will be if given enough time, will prevent fatalities.

The administration of intravenous anesthetics, *i.e.* pentothal sodium, evipal, without having a gas machine with oxygen and a mask available and ready to use, is fraught with danger. Nevertheless, this practice still prevails and indicates a lack of knowledge and common sense of the administrator.

Anesthetics are only as safe as the administrator of the agent is safe.

The importance of the anesthetist can be realized when the following factors, which are primarily responsible for deaths following anesthesia, are considered. These factors over which he has direct control are: excessive quantity of the agent, the occurrence of respiratory obstruction during operation, inadequate oxygen, poor management, insufficient or excessive replacement therapy, error in technic, and inadequate supervision during the operation and in the immediate postanesthetic period.

Since it is impossible for the conscientious surgeon to give his undivided attention to the surgical procedure and anesthetic management at the same time, he therefore naturally expects and demands that his anesthetist be competent, intelligent, alert and careful.

Surgeon-anesthesiologist relationship is comparable to that of a captain of a seagoing ship and the harbor pilot. The captain acquires a pilot to navigate his ship through the treacherous reefs, shoals and sandbars which impede his entrance into the harbor and the ship's piers. The captain is dependent upon the pilot's knowledge and competency.

The surgeon, likewise, calls upon the anesthesiologist for his knowledge and ability to conduct the patient through a surgical procedure without contributing to the morbidity which is inherently prevalent following any surgical procedure. In the surgeon-anesthesiologist relationship we must not overlook the obligation of the surgeon.

The surgeon should have his patient as well prepared for anesthesia as possible, and when in doubt about the condition of his patient should consult with the anesthesiologist before an operation is scheduled. The interest of the patient is best served when the anesthesiologist examines him and his record before the operation.

The administration of an anesthetic entails more than the "pouring" on the ether, turning valves on a gas machine, the sticking of a needle in the vein or spinal canal or a tube into the trachea to produce anesthesia. Anesthesia is dependent upon a thorough knowledge of the basic principles of anatomy, chemistry, pharmacology, physiology, physics and psychiatry. The understanding of these basic concepts and the application of sound clinical physiological principles by the anesthesiologist during the conduct of an anesthesia will appreciably decrease the morbidity and mortality following anesthesia.

Since there is no ideal anesthetic free from toxicity, and the surgeon realizing that deaths do occur following anesthesia which are preventable by the anesthetist, it behooves the surgeon to demand that the person whom he calls upon and entrusts the life of his patient be attentive, competent, intelligent and a clinical physiologist. It is only through the surgeon's perseverance in demanding such basic knowledge and abilities of the anesthetist that the art and science of anesthesiology will develop and attract physicians to the specialty and assume its rightful heritage in the practice of medicine. Such insistence by the surgeon of the anesthesiologist then will be an incentive for him to constantly strive to improve, develop and apply the newer concepts promulgated in the fields of medicine.

No patient should die as a result of the anesthetic alone.

PAUL H. LORHAN, M.D.

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BOOK REVIEWS

The Editors of THE AMERICAN SURGEON will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The editors do not, however, agree to review all books that have been submitted without solicitation.

MONOGRAPHS ON SURGERY. By B. NOLAND CARTER, M.D., Ph.D., Editor, Professor of Surgery, University of Cincinnati, Director of the Surgical Services, Cincinnati General Hospital. Advisory Editors—Gynecology: JOE V. MEIGS, M.D., Clinical Professor of Gynecology, Harvard University Medical School; Chief of the Vincent Memorial Hospital. Urology: CHARLES HUGGINS, M.D., Professor of Urology, University of Chicago, Chairman of Committee on Cancer, University of Chicago. Orthopedic Surgery—ALFRED R. SHANDS, M.D., Medical Director, Alfred I. DuPont Institute of the Nemours Foundation. Baltimore, The Williams and Wilkins Company, 1952. 413 pages with illustrations plus references and index.

This is a collection of 15 monographs on various surgical subjects, and is the third such volume which has been brought to the surgical profession. These volumes are replacing the previously published Nelson's Loose Leaf Surgery. It is thus the hope of the editor and publisher that as time goes on one may acquire a collection of valuable reference books on surgical subjects.

The largest group of these monographs deals with the problem of female urinary incontinence and is introduced by Dr. Joe Meigs. It is very comprehensive and represents some of the best opinions on this subject.

The monograph on radioactive iodine is prepared by Dr. Geo. Curtis, a pioneer in this field and is well worth the cost of the entire volume.

Other sections covered include: Pancreaticoduodenal cancer by A. O. Whipple; Chest injuries by Brian Blades; Fractures of long bones by G. W. N. Eggers; Intracapsular fracture of femoral neck by Schottstaedt, Larsen and Bost; Aseptic necrosis of femoral head by Wm. Cooper; Arthroplasty by Robert A. Knight; Ureteral and pelvic dilatation by Frank Hinmon, Jr.; Renal neoplasms by W. F. Whitmore, M.D., and Surgery of large arteries by Norman E. Freeman, M.D.

Each of these monographs is a separate and distinct article which is well written, easily understood and well worthwhile. The publisher has furnished a good binding and good paper. The illustrations are well reproduced and the printing is easily legible.

This is an excellent collection of timely subjects.

A. H. LETTON, M.D.

THE METABOLIC RESPONSE TO SURGERY. By FRANCIS D. MOORE, M.D., Moseley Professor of Surgery, Harvard Medical School, Surgeon-in-Chief, Peter Bent Brigham Hospital, Boston, Massachusetts, and MARGARET R. BALL, A.B., Department of Surgery, Harvard Medical School Laboratory for Surgical Research, Peter Bent Brigham Hospital, Boston, Massachusetts. Metabolic Diagrams by MILDRED B. CODDING, A.B., M.A., Surgical Artist, Department of Surgery, Harvard Medical School, Peter Bent Brigham Hospital, Boston, Massachusetts. Springfield, Charles C Thomas, Publisher. 138 pages with appendix and bibliography.

This is a unique volume of valuable information—information that hitherto we have known existed yet we have been tardy to recognize. In all operations the surgeon and his team supply anesthesia, asepsis and hemostasis while the patient supplies his “biological response” which is equally essential to survival and success. It is with this “biological response to surgery” that this volume deals.

The volume deals with research done at the Massachusetts General Hospital and the Peter Bent Brigham Hospital. From these research problems there can now be seen certain distinct patterns of “biological response to surgery.” These are described and examples are cited.

With this research and their summarization in the volume one can see a new dimension in surgical care for we can realize that every operation is an experiment in bacteriology and biology. With this work as a backdrop it will save much work and mass experimentation for the practicing surgeon in acquiring a more accurate quantitative concept of the clinical changes experienced by his patients.

In such a new field one can rest assured that this volume is only a progress report and soon may be relegated to the level of a primer of surgery for the biological response to trauma includes alteration in cellular function, hematology, the function of specific parenchymatous organs and psychological adjustments. With these thoughts in mind, this volume takes on a new importance. It is thus a needed book in every surgeon's library.

A. H. LETTON, M.D.

Books received are acknowledged in this section, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

SURGERY AND THE ENDOCRINE SYSTEM. By James D. Hardy, M.D., F.A.C.S., Assistant Professor of Surgery, University of Tennessee Medical College. Philadelphia, W. B. Saunders Company, 1952. \$5.00.

AN ATLAS OF GENERAL AFFECTIONS OF THE SKELETON. By Sir Thomas Fairbank, D.S.O., O.B.E., M.S., Hon. M.Ch.(Orth.), F.R.C.S., Consulting Orthopaedic Surgeon and Emeritus Lecturer in Orthopaedic Surgery, King's College Hospital; Consulting Surgeon, Hospital for Sick Children, Great Ormond Street; Emeritus Consulting Surgeon, Lord Mayor Trelor Orthopaedic Hospital, Alton; Honorary Consultant (Orthopaedic) to the Army. Baltimore, The Williams and Wilkins Company, 1951. \$10.00.

SURGICAL TECHNIQUE. By Stephen Power, M.S., F.R.C.S., Senior Surgeon to the Dreadnought Hospital, Greenwich; Surgeon to the Royal London Homeopathic Hospital; Surgeon to Eltham Hospital. Philadelphia, J. B. Lippincott Company, 1952. \$6.50.

TEXTBOOK OF SURGICAL TREATMENT INCLUDING OPERATIVE SURGERY. By C. F. W. Illingworth, C.B.E., M.D., Ch., F.R.C.S.E., F.R.F.P.S. (Glas.) Regius Professor of Surgery, University of Glasgow, Compiled by twenty-two contributors. Fourth edition. Baltimore, The Williams and Wilkins Company, 1952.

ABSTRACTS FROM CURRENT LITERATURE

PREVENTION OF POSTOPERATIVE PULMONARY INFECTIONS BY INHALATION OF MICRONIZED PENICILLIN. John A. Dixon and Earle B. Mahoney. *Rocky Mountain Medical Journal* 49:122-125. (Feb.) 1952.

A series of 150 thoracic and upper abdominal operative cases were given micronized penicillin by inhalation preoperatively and postoperatively in an attempt to prevent postoperative pulmonary infections. The day prior to operation, a nasopharyngeal culture was taken, plated for penicillin sensitivity and 200,000 units of micronized penicillin was given by inhalation. On the day of operation, 100,000 units was given before operation and repeated as soon after operation as the patient was able to cooperate. One hundred thousand units was given on each of the first two postoperative days and on the third day another culture was taken and penicillin sensitivity of the flora was again determined.

There were eight complications including 1 case of bronchopneumonia and 7 cases of atelectasis for an over-all morbidity of 5.3 per cent. This compares with 19 per cent in a control series of untreated cases at the same hospital.

The conclusion is drawn that micronized penicillin by inhalation is an agent of considerable value in prevention of pulmonary inflammation when used prophylactically in operative cases.

R. H. S.

CARCINOMA OF THE AMPULLA OF VATER. Louis C. Bennett. *California Medicine* 76:289-296. (April) 1952.

Herein, Bennett reports 3 cases of carcinoma of the Ampulla of Vater who survived 12, 11, and 10 years following pancreaticoduodenectomy. (Since this paper was written, 1 of these patients died of carcinoma of the body of the pancreas but whether this was a recurrence, a metastasis or an independent lesion could not be determined.) These patients were operated on by the late Dr. Verne C. Hunt. There is no evidence of recurrence in the other 2 patients and this report is based upon observation in recent surgical care in 2 of the patients and upon direct information of the other patient.

Two of these cases had previously been reported by Dr. Hunt. Two other cases treated by duodenotomy and local resection of the lesion died two and four years after operation.

R. H. S.

CARCINOMA OF THE BREAST. Results of Treatment in a Small General Hospital. John J. Zellinger and George C. Adie. *Annals of Surgery* 135:173-183 (Feb.) 1952.

The qualified general surgeon outside a large medical center with the complete surgical care of the community on his shoulders must treat cancer of the breast as well as the laborer with the fractured ankle and the child with intussusception. He therefore must guard against identifying his own results in the treatment of a specific entity with those reported by the larger clinics and teaching institutions where surgical therapy is departmentalized. Herein the authors analyze the results of the treatment of cancer of the breast in a 350 bed general hospital (New Rochelle Hospital, New Rochelle, N. Y.) and compare them with results reported by larger centers.

The case material consists of 153 patients admitted between 1938 and 1945 whose disease proved after proper investigation to be carcinoma or sarcoma of the breast. These cases represent the experience of the staff as a whole. The over-all five-year absolute survival rate was 42.7 per cent and the over-all five-year survival rate in only those patients having radical mastectomies for malignancies of the breast was 47.8 per cent. The rate of skin recurrence after operation was 21.9 per cent. Though these figures leave much to be desired, they compare favorably with the results reported by many of the larger clinics in this country.

R. H. S.

THE DIAGNOSTIC VALUE OF VERTEBRAL BODY NEEDLE BIOPSY. Robert Mazet and Lewis Cozen. *Annals of Surgery* 135:245-252 (Feb.) 1952.

Of 36 cases in which biopsy was taken of the body of a vertebra (3 by open method and 33 by needle biopsy) a definite diagnosis was made from the biopsy material in 17 instances. In 9 patients who had fractures due to osteoporosis, malignancy was ruled out. In 10 instances, the material obtained was of no value. The authors have included detailed description of the technic employed at the various levels of the vertebral column. In the thoracic region, they have utilized an open approach with resection of a 3 cm. segment of rib. Fine Kirschner guide wires are inserted and the position checked by roentgenogram and the needle is inserted over the guide wire. The procedure is usually performed on the left to avoid injury to the inferior vena cava.

The authors conclude that needle biopsy of indeterminate vertebral body lesions using the technic that they have employed is a safe procedure yielding information of diagnostic value in a significant proportion of cases.

R. H. S.

THORACIC CAGE CLOSURE AFTER THORACOTOMY OR THORACO-ABDOMINAL EXPLORATION. Richard H. Overholt and Leo J. Kenny. *Surgery, Gynecology and Obstetrics* 94:365-368 (March) 1952.

For the past two years, the authors have employed a method of opening and closing the thorax in which no rib is sacrificed and by which the thoracic cage is immediately restored to its original state of rigidity and mobility. The rib cage is opened by a long intercostal incision and one or more ribs above or below are divided. In the closure, the rib ends are reunited and fixed in a manner similar to a carpenter's mortise and tenon. After drill holes are made near the ends of the ribs, the corners of the distal rib end are removed with a small ronguer. The outer and inner cortex of the rib end becomes a double tenon. The marrow of both the distal and proximal rib ends is hollowed out. Double silk ligatures are then passed through the holes, the rib ends fitted with the outer tenon being fitted into the marrow cavity of the proximal stump and secured by tying the ligatures. The intercostal incision is then closed in the usual manner.

The writers conclude that mortise and tenon fixation provides a practical way to reunite ribs that have been divided.

R. H. S.

